21 MAR 1923

BERMUDA

REPORTS

OF THE

BOARD & DEPARTMENT

OF

AGRICULTURE

FOR THE YEAR

1921

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BOARD OF AGRICULTURE, 1921.

Chairman, Col. W. R. Winter, J.P., O.B.E., Paget

Vice-Chairman, Honble. S. S. Spurling, M.C.P, O.B.E, St. George's

Wor. T. H. H. Outerbridge, J.P., M.C.P, Hamilton
A. W. West, Esq., Hamilton
Jas. H. Hollis, Esq., Hamilton
H. A. Peniston, Esq., M.C.P., Smiths
Dr. F. W. E. Peniston, V. S., Smiths
B. C. C. Outerbridge, Esq., Smiths
E. F. Zuill, Esq., M.C.P., Devonshire
W. A. Barnes, Esq., Southampton
Wor. T. St. G. Gilbert, Sandys
O. Cooper, Esq., M.C.P., Sandys

DEPARTMENT OF AGRICULTURE, 1921.

Director of Agriculture—E. A. McCallan

-First Assistant (Plant Pathologist)—H. H. Whetzel, A.B,, M.A.

Second Assistant—J. J. Outerbridge.

*Government Veterinary Officer—R. L. Tucker, D.V.S.

*-Inspector of Produce—R. W. Browne

*-Inspector of Green Vegetables—G. E. Winter

*-Assistant Inspector of Produce—F. W. Williams

*-Assistant Inspector of Produce—T. H. Doe

*-Assistant Inspector of Green Vegetables—E. L. Adams

*Clerk to Board—E. G. Perinchief

*Not whole time officers.

-Not on Civil Service establishment.

AGRICULTURAL STATION,

Bermuda,
21st March, 1922.

Sir:—

I am directed by the Board of Agriculture to lay before His Excellency the Governor, for the information of the Legislature, the accompanying report of the Board and Department of Agriculture for the year ended 31st December, 1921.

I have the honour to be,
Sir
Your obedient servant,
G. L. YOUNG,
Clerk to Board of Agriculture.

The Honourable,
The Colonial Secretary.
Hamilton, Bermuda.

Report of the Board of Agriculture

FOR THE YEAR 1921

The Board met on twenty-three occasions during the year. The average attendance was eight, with a membership of twelve.

Agricultural Station

During the year under report the Colony has acquired the property east of the Station which will be used for Station and Exhibition purposes, a reservation being made of a small portion to the north for the erection of quarters for the Medical Superintendent of the Hospital and possibly for other members of the Civil Service. The aquisition of the property forms a most valuable asset to the Colony.

The recently appointed Director has performed most excellent work during the year. Special attention is drawn to the sections of his report dealing with the potato experiments and with marketing and distribution. The improved conditions of the grounds bear testimony of the care and attention given them. The report of the Director deals fully with the work done.

Temporary Appointment of Prof. H. H. Whetzel

The Colony has been most fortunate in securing for the period of one year the services of Professor H. H. Whetzel, A.B., M.A., Senior Plant Pathologist of the New York State College of Agriculture, Cornell University, who has since his arrival in June worked most indefatigably in the survey of local plant diseases and pests.

His valuable report, attached, indicates the extent and thoroughness of his investigations. Measures for the control of the diseases and pests have been kept constantly before the public in the local press. If the information so generously disseminated is taken thorough advantage of by the public, it will result in the saving of crops to the value of thousands of pounds, as at present a very large percentage of all crops is lost by disease and insect pests

The presence of Professor Whetzel was of the greatest value in studying and elaborating the control measures necessary to minimize the disastrous effects of the oleander scale. He has devoted a considerable amount of his time to the supervision of and instruction to the spraying operators. The control work is progressing faster than anticipated and with favourable results.

The work of Professor Whetzel has proved most emphatically the absolute need for the addition of a Plant Pathologist to the Department of Agriculture.

Live Stock

With a view to the further improvement of the dairy stock in these Islands the Department imported during the year one registered Guernsey bull and two registered cows of the same breed. The pedigrees of these animals which are on view at the Station show an admixture of the famous "May Rose" blood with some of the best-bred Guernsey stock in the United States.

We are pleased to state that owing to the careful supervision of the Government Veterinary Officer, Dr. R. L. Tucker, V. S., there has been no serious outbreak of infectious disease, and again there have been no cases of hog cholera or swine fever.

Consolidation of Acts

The consolidation of the Agricultural Acts long in contemplation has this year been accomplished and new Regulations under their provisions have been framed.

Many reforms and improvements have been effected particularly in the inspection service. A new Act entitled the "Plant and Bulb Diseases and Pests Act" has been framed and put in operation, under it authority is given to prohibit the importation of plants, bulbs, fruits, etc, and also provides for the right to inspect any importation of any item coming within the scope of the regulations.

The following appointments have been made:

Mr. J. J. Outerbridge, Second Agricultural Assistant.

Mr. G. L. Young, Clerk to the Board of Agriculture and Director.

Mr. G. E. Winter, Inspector of Produce under the new Inspection Act. He is now a whole time officer.

Financial

Statements of the disbursements of the various grants at the disposal of the Board, and the receipts from the Agricultural Station will be found in the appendices.

W. R. WINTER,

11th. February, 1922. Chairmain, Board of Agriculture, 1921.

REPORT OF THE DIRECTOR OF AGRICULTURE FOR THE YEAR 1921

The Chairman,

Board of Agriculture.

I have the honour to submit my report for the year 1921, together with reports of other officers of the Department, under the provisions of the Agricultural Department Act, 1921.

Agricultural Station

Oleander Scale Control. In 1917 a scale was observed on oleanders at the Station and elsewhere in Paget. The infestation at the Station was checked for a time by spraying, but during the following years, through lack of control measures, it spread to every oleander on the grounds. A few poorly nourished trees were killed by the scale.

In November, 1920, the recently appointed Director, then holding the office of Acting Colonial Surveyor, had the pest identified in the United States as the West Indian peach scale (Aulacaspis pentagona (Targ.)), and obtained from the New York State College of Agriculture information concerning its control. In March, shortly after the Director assumed his duties, the control of the scale was taken up, and varying strengths of black-leaf-40, kerosene emulsion, lime-sulphur and scalecide, also kerosene, were tested. The tests were repeated in May. In July the trees were examined, and it was found that lime-sulphur, scalecide and kerosene emulsion were effectual in the order named, and the first was selected for future use. At this time trees found to be still infested were sprayed with lime-sulphur; for the most part infestations were confined to trees which had been left unsprayed as checks or had been sprayed with insecticides not well suited to the control of this pest. An examination made at the close of the year disclosed a very few slight infestations.

The natural history of the scale and the measures adopted to control it throughout the Islands are treated elsewhere in this report.

POTATO EXPERIMENTS.—Owing to the peculiar circumstances in which the Department was placed during the season of 1920-1921, no tests of special interest were undertaken. The Bliss Triumphs dug in January produced the largest crop of that variety grown on the experimental plots; 68 barrels, including culls, were dug from 124 rods, a good crop considering the character of many of the experiments. In contrast to this was the crop of Chili Garnets, which were planted in February and dug in June, and gave 34 barrels only. Lack of rain and stall manure was the cause of this small crop. The experiments conducted with the two varieties were repetitions of previous tests.

The Bliss Triumphs planted in October of the year under report included the following strains:

(1) Maine seed grown on Long Island, New York. Samples were procured from growers in different districts of the Island.

(2) New Brunswick strains. (a) Original and (b) J. W. Smith strain grown in New Brunswick one season.

(3) Wisconsin strains. (a) J. W. Smith strain and (b) Sunset Farm strain.

(4) Nebraska strain. Grown by G. F. Forsling, Bushnell, Nebraska.

(5) New York strain. Grown at Batavia, New York, from Wisconsin stock.

Through the courtesy of Prof. Wm. Stuart of the United States Bureau of Plant Industry and Mr. H. B. Fullerton, Director of the Long Island Railroad Demonstration Farm, some of the strains mentioned will be further tested at the Federal Experimental Station, Presque Isle, Maine, and at Medford, Long Island. Comments on the behaviour of the strains named will be found under the section on potatoes.

Experiments are being conducted with seed cuts weighing from half ounce to two ounces planted at different distances apart and in different positions. The fertilizer tests include applications at different times and in quantities varying from five to fifteen pounds per rod. The fertilizers used are castor pomace, both coarse and fine, and H.O.P., an English complete fertilizer. This fall there have been undertaken comparative tests of spraying and dusting to control diseases and pests. The high winds of December were very destructive to the potatoes, and made it impossible to continue the tests.

In the light of experiments conducted for several years, the following recommendations are made:

(1) Leguminous green manuring with cowpeas or soy beans will greatly increase the fertility of the soil and the yields of crops grown thereon. Heavier yields will result, as a rule, if light dressings of stall manure are added, though excellent crops of potatoes have been grown at the Station on green manures alone.

(2) Thorough deep cultivation before planting, and frequent shallow cultivation up to the time of moulding will result in increased yields.

(3) Treatment of the seed with formalin will decrease the risk of loss through common scab and a few other diseases

(4) Seed pieces cut to weigh 1 1-2 ounces each, and planted 9 inches by 22 inches apart is good practice.

(5) Care should be taken to place the seed pieces in the ground with eyes uppermost.

(6) When the potatoes are about two inches high, fertilizer at the rate of from five pounds to ten pounds per rod, according to the degree of soil fertility, should be broadcast between the rows and cultivated or forked into the soil.

(7) Early high moulding will lessen the risk of wind damage.

(8) Early, thorough and regular spraying with carefully prepared Bordeaux applied with a force of at least 100 pounds through a good nozzle will control early and late blight, and prevent rotting of tubers by the latter. The addition of 1-2 pound paris green or 2 pounds arsenate of lead to 50 gallons of Bordeaux will control fire-worms.

VEGETABLE EXPERIMENTS.—The experiments with vegetables were largely confined to tests for trueness to type under the provisions of the Vegetable Seeds Act, 1919. As a rule the seeds imported have been found to be as representated by the vendors, though beet sometimes contains a relatively high percentage of light-coloured roots, and lettuce often fails to produce a crop of saleable plants.

Of the eleven strains of Early Flat Egyptian and Crosby Egyptian beet under test in the winter of 1921, the average per centage scored for colour of flesh was 68. In the fall fifty-four strains representing six varieties were planted. The seed was imported from England, France, Denmark, Italy and the United States, and, in addition, obtained from local importers.

Fourteen strains of Chantenay and Danvers carrot were planted in the winter of 1921. The former is recommended as the more suitable variety to plant for export. This year it averaged 111 1-2 pounds per 100 feet of row, and Danvers 103 pounds; and scored 85 points for shape, colour of flesh and trueness to type in comparison with 75 points scored by the other variety.

Mammoth White cos lettuce was tested at the Station and on many farms last winter, and was found to be inferior to White Heart. Thirty-seven strains and varieties of cos lettuce are under test this fall and winter. The majority of samples were obtained from France, and a number give promise of being suitable for the New York market.

The first picking of Golden Bantam sweet corn was made on thirtieth April. If heavily manured this variety will crop well, and is unsurpassed for earliness and flavour.

Hollybrook and Ito San soy beans were planted on eleventh July, and the former especially gave a good crop of beans. The cultivation of the soy beans as a summer crop is strongly recommended. The green shelled beans are delicious for table use, the plant is an excellent fodder, and is a valuable nitrogenous green manure when the soil is inoculated with its bacteria. As a green manure it does not yield as heavily as the cowpea, but is more cheaply plowed under.

In the fall of 1921 there were under test three hundred and twenty-six varieties and strains of vegetables.

ONION EXPERIMENTS.—Samples of onion seed were obtained from the Canary Islands in 1920 by the former Director, Mr. E. J. Wortley, and other samples were obtained locally; in all fifteen samples were under test. Close counts were made of the percentages of undesirable red and pink-skinned bulbs, and the results are summarized as follows:

(1) The strains selected by Mr. Wortley averaged 15 per cent.

(2) The strains purchased by the trade from recommended sources averaged 25 per cent.

(3) The strains purchased by the trade from sources condemned by Mr. Wortley averaged 45 per cent.

Again this fall samples have been obtained from the Canaries and local dealers, and are now under test. Heavy applications of nitrogenous fertilizers have been applied to check the injury caused by pinkroot.

LILY EXPERIMENTS.—Samples of bulbs were obtained from a few growers in 1920, and were under observation during the following winter and spring. It is evident that some stocks are purer, more vigorous and freer from disease than are others, and their superiority is largely due to greater care in the selection of planting stock, roguing, spraying and rotation. As the bulbs under observation included the Bermuda Easter Lily type (L. longiflorum var. Harrisii) and more recently imported Japanese (L. longiflorum var. giganteum) bulbs, a comparison was made of the earliness of bloom. The former were in full bloom before the end of March and the latter not until the middle of May.

This fall extensive tests are being conducted by the Plant Pathologist, and are treated of in his report.

FRUIT.—Again the citrus trees have failed to bear, though manured and fertilized in April. Infectation of purple scale (Lepidosaphis beeki) and cloudy white fly (Dialeurodes citrifolii) has been severe, and labour has not been available to bring it under control. A large crop of loquats was grown, and was fairly free from injury by the Mediterranean fruit fly (Ceratitis capitata). A young Japanese persimmon fruited heavily and the young guavas and loquats, all imported and planted in 1917, also fruited. Papaws grown from seed donated by G. C. Oddie, Esq. fruited for the first time; they were of good flavour and unusually large, weighing from four to five pounds each. During the year spraying and dusting experiments have been undertaken, but are not sufficiently advanced for report. As it is extremely difficult to secure ripened fruit because of thieves, the orchard should be enclosed.

LAWNS AND ORNAMENTAL BEDS.—Many trees and shrubs have been transplanted and other changes made to improve the appearance of the grounds, especially of the office plot, long

an unsightly blemish. A rose bed containing seventy-eight bushes has been made north of the large mixed border and the lawn nearby has been graded and improved. Acalypha and other shrubs on the south bank have been removed and a hedge of Cape trumpetflower (Tecomaria capensis) has been planted beside the boundary wall. The old house near here has been cleared of rubbish and will be made into a fernery. All the ornamental beds and borders, except those near the north entrance, have been manured, forked and in some cases replanted. A few new borders have been made. During the year all the glasshouse plants have been repotted and some additions made thereto. Since the commencement of the building of the King Edward VII Memorial Hospital in 1913 the north entrance to the Station has been very unsightly, and it is desirable that the area to be allocated to the Station should be fixed in order that this, the principal entrance, can be laid out in an attractive and suitable manner.

An attractive display of annuals, particularly snapdragon, larkspur and stocks, beautified the lawns during the late winter and spring, and were followed by zinnia and celosia, both rather disappointing; from early October until the first week in December Klondyke cosmos made a grand show. A few plants have flowered this year more abundantly than previously, among them beaumontia (Beaumontial grandiflora) and purple wreath (Petrae volubilis). A small exhibit of flowers was shown at the Villa Mont Clare Flower Show in May. The storm of September badly damaged many trees and shrubs.

The Department is under obligation to Dr. N. L. Britton of the New York Botanical Garden; R. Ward, Esq., Director of the Botanis Garden, Demerara; Eugene Andre, Esq., Trinidad; Col. C. B. Harvey, C.R.E; Hon. Hy. Lockward, R. S. Jaffray, Esq; and Miss A. P. Lough for donations of plants, bulbs, cuttings and seeds.

LIVE STOCK.—In April the Ayrshire bull Hillside Spicey's Laddie was removed from the farm of Dr. J. W. Cann, M. C. P., Sandys, where he had been standing for service since January, 1919, to be treated for a fiberous tumour. He has since improved to a marked degree, and is now being offered for sale. The young Ayrshire, Pinebluff Laddie, the gift of R. B. Angus, Esq., of Montreal, is well conditioned and stocky, though rather small for his age. The Department is grateful to James Morgan, Esq., of Southlands, Warwick, for offering to board this bull on his farm for a time free of cost.

An appropriation of £850 having been made for the improvement of live stock, Dr. R. L. Tucker, V.S., Government Veterinary Officer, was directed by the Board to go to the United States and purchase three Guernsey animals. From the herd of Mr. John C. Haartz at Campton, N. H., the following were selected:

ALBAMONT ADONIS (64054); sire, Don Diavolo of Linda Vista; dam, May King's Dancer of A. D. F.; born 30th March, 1920; breeder, J. C. Haartz.

DORA OF ATWOOD'S DAIRY (73697); Sire, Jethro's Squire of Maple Ranch; dam, Idol's Eleen; born 7th January, 1917; breeder, the estate of John Hopewell, Natick, Mass.; in calf to Albamont Sovereign.

ALBAMONT JULIET (85736); sire, Deanie's May King; dam, Juliana of Gerar; born 20th April, 1918; breeder J. C. Haartz, in calf to Cramond Defiance.

These animals are possibly the best bred dairy stock ever imported into these Islands, and should influence local cattle for many years to come. The Board fixed the service fee for Albamont Adonis at twenty shillings, and for the two Ayrshires at eight shillings each. A record is kept of all services, which have totalled 67 for the three, exclusive of 9 services by Hillside Spicey's Laddie while in Sandys.

The two cows, Dora and Juliet, were, naturally, seriously checked in their milk flow by the sea voyage in July and the change to Bermuda conditions. Dora was dried off in September and Juliet in December. The following is their production:

Dora of Atwood's Farm (77 days) 665 pounds.

Albamont Juliet (179 days) 2438 pounds.

DISPOSAL OF MILK, VEGETABLES AND PLANTS.—Since July 518 quarts of milk have been sent to the King Edward VII Memorial Hospital, the remainder being used by the Staff with the consent of the Board. Vegetables from the experimental plots are disposed of by sale, or by donation to the Hospital and other Government institutions. Surplus vegetable seedlings, plants and cuttings are sold at nominal rates. No charge is made for vegetables and plants sent to bazaars and other charitable sales. The value of the products sold and donated to other Government Departments is shown in Appendix B.

GREEN AND STALL MANURING.—Nearly all the vegetable plots were planted to Mammoth Yellow soy beans, after having received a moderate dressing of stall manure. Eight tons per acre was produced, the greater part of which was forked under for green manure, and the remainder fed to the stock. The potato plots were deeply plowed, and on ninth and eleventh July were sown to mixed cowpeas and soy beans. In fifty-one days a crop yielding at the rate of ten tons per acre was grown. Previous to the year under report no stall manure was produced at the Station, and it was difficult to purchase any; by the use of leguminous green manure only the fertilty of the soil was scarcely maintained. The presence of live stock this year has resulted in a quantity of stall manure being available for the experimental plots and ornamental beds; a further quantity was purchased, and the crops now growing have responded to the more liberal use of green and stall manuring.

LABOUR.—Lack of efficient workmen has often retarded the experimental work of the Station, nor has it been possible to

keep the grounds in as orderly condition as desirable. Since 1914 wages have advanced 37 per cent. and hours have been reduced, but the workman of to-day, as a rule, does less work than did the pre-war labourer. For some months a relief was found in the employment of four men of the Royal Sussex Regiment, and the Department is under obligation to the Officer Commanding Detachment for the courtesy. A similar courtesy has been extended by the Officer Commanding Detachment East Lancashire Regiment, but the men do not appear to be attracted to agricultural work. Changes are contemplated with the view of reducing labour costs, for instance, much time would be saved by the installation of an electrical pump, as nearly all the water used for all purposes is now pumped by hand at an annual cost of more than £50.

VISITORS.—Among the foreign visitors who called at the Station during the year were Mr. Wm. Robson, Curator of Montserrat; Mr. A. M. Porter, Secretary of the Ontario Agricultural College, and Prof. Chamont of Cornell University, New York. His Excellency the Governor, Sir James Willcocks, was present at the spraying demonstration in November, and is not an infrequent visitor.

The public, and especially the farming community, do not visit the Station as often as might prove profitable to them. The numbers who have inspected the recently imported dairy stock have been very disappointing.

OFFICE WORK.—The office work has increased during the year. Letters and minutes to the number of 635 have been received and 1,054 dispatched. Monthly planting notes and other articles of general interest, chiefly from the pen of the Pathologist, have been sent to the local press. Early in the year was begun the filing and recording of bulletins received; the work is nearly completed, and selections are being made to complete the files. Many additions have been made to the herbarium. The consolidation and amendment of the acts dealing with agriculture, and the drafting of new regulations thereunder has consumed much time. In all twenty-two acts have been consolidated into two, and a new one framed. The following acts are now in force:

The Agricultural Department Act, 1921.

The Agricultural Inspection Act, 1921.

The Plant and Bulb Diseases and Pests Act, 1921.

PURCHASE OF MONTROSE.—The property of Montrose, contiguous to the Station, and consisting of thirteen acres of land, with buildings, was purchased for 5,500. pounds. The dwelling house and two acres of land have been allocated to the King Edward VII Memorial Hospital, and the remainder of the land to the Station.

The addition of Montrose to the Station makes it possible to keep breeding stock, increases by about two hundred per cent the

area suitable for field experimental work, and provides a permanent site for agricultural exhibitions. Under existing labour conditions, the work of effecting improvements will be protracted.

Control of Oleander Scale

As already noted, the West Indian peach scale (Aulacaspis pentagona (Targ.)), known locally as the oleander scale, was first observed in 1917. In 1920 infestation had become so general, especially in the centre of the Islands, that many had become alarmed at the possibility of the extinction of the oleander. Mr. J. J. Bushell, M.B.E., Editor of the Bermuda Colonist, gave considerable publicity to the matter in his paper, and was in no small degree responsible for the enactment of the White Scale Act, 1920. However, no action had been taken under its provision when it expired at the close of that year.

In March of the year under report the attention of the Board was drawn by the recently-appointed Director to the serious nature of the scale, and control measures were recommended, the cost to be borne partly by the owners of infested trees. The Board were of opinion that action should be delayed until the arrival of Prof. H. H. Whetzel of the New York State College of Agriculture whose temporary appointment to the Department was expected to take place in June, for at that time the Director was the solitary wholetime officer in the Department.

In Prof. Whetzel's first monthly report, presented to the Board on sixth July, prominence was given to the scale, and recommendations were made on the whole similar to those made by the Director in March. On this date the Board were prepared to act, and a bill entitled the Plant and Bulb Diseases and Pests Act, 1921, was introduced into the House of Assembly by Mr. W. A. Moore, who had previously asked for a report from the Department on the subject. The act came into operation on 12th September. Under its provisions 700 pounds was appropriated, which sum was subsequently increased by the addition of 300 pounds, and the Board undertook the control of the scale without cost to the owners of the infested trees. From this time on the public were informed concerning the nature and control of the scale by newspaper articles, control demonstrations, exhibits of photographs and infested plants, addresses at public meetings and instruction in the schools. This educational campaign was vigorously prosecuted by the Pathologist.

For the control of the pest two 2 1-2 horse-power motor pumps manufactured by the Friend Manufacturing Company of Gasport, New York, were purchased at a cost of £298-13-1, landed here; extra fittings, hand pumps and other apparatus to the value of £129-11-11 were also purchased. In the light of the experiments conducted at the Station since March, lime-sulphur was selected as the most suitable insecticide, and has been used in the proportion of one part to ten parts of water. Mr. D. C. Stephens was appointed Field Supervisor, and on ninth November spraying oper-

ations were begun at St. George's. At the close of the year all known infestations in that parish, in Sandys and in the greater part of Warwick and Southampton had been sprayed. Mr. Stephens has proved to be energetic, careful and resourceful, and is supervising the work well. The gangs are working satisfactorily. Despite the greatly increased infestation since control measures were first recommended and the excessive rain during the months in which work has been carried on, progress has been more rapid than was anticipated, and the task does not now appear as herculean as when first contemplated, yet it is impossible to refrain from expressing regret that earlier action was not taken. The possibility of controlling the scale by the introduction of parasites is dealt with by the Pathologist.

Acknowledgement is made of the Department's indebtedness to the Furness Bermuda Line for its generosity in transporting free of cost all insecticide used.

Potatoes

The improvement of seed potatoes continues to demand the attention of the Department. During the summer of the year under report the Director visited Long Island, New York; Aroostock, Maine; Fredericton, New Brunswick, and districts in Nova Scotia to field inspect Bliss Triumphs and Chili Garnets being grown for the Bermuda trade. Occasion is here taken to acknowledge the valuable assistance afforded by Dr. H. C. Sands of the New York State Department of Farms and Markets, Prof. Wm. Stuart and Prof. E. S. Schultz of the United States Bureau of Plant Industry, Mr. J. H. Philbrick. County Agent for Aroostook, Maine, and Prof. G. C. Cunningham and Mr. W. K. McCulloch of the Dominion Division of Botany. To Mr. McCulloch are the farmers of these Islands under special obligation.

The weather conditions in Long Island during the summer of 1921 were unfavourable because of scanty rain-fall, and fusarium wilt was much in evidence, particularly on potatoes in light soils deficient in humus. On the low-lying heavier soils, especially in the Orient district, better conditions obtained. Counts of mosaic and leaf-roll gave averages of 22 per cent and 4 per cent respectively.

As was anticipated, much loss through fusarium stem-rot occurred in the seed during the time it was held in Bermuda previous to planting. For several years an endeavour has been made to restrict to the heavier soils in Long Island the planting of Bliss Triumphs intended for seed purposes in Bermuda, and to reduce the loss through fusarium rot a more determined effort should be made to secure this desideratum. The firms interested in the growing of Bliss seed in Long Island for the Bermuda trade were interviewed or approached by letter with the view of securing their more hearty co-operation in the production of seed satisfactory to the farmers of the Colony.

Three fields containing 70 acres were inspected and accepted in Van Buren Township, Aroostook County, Maine. The percentage of leaf-roll observed was 8-10th of 1 per cent. Mosaic of a very mild form averaged 40 per cent. The growth and vigour of the vines were excellent, and the cultural conditions were satisfactory. Arrangements were made with a reliable firm in Caribou, Maine, to supply a sufficient quantity of the accepted seed to the Long Island growers.

When inspected on 1st August the Bliss Triumps being grown at Fredericton, New Brunswick, for Bermuda were suffering severely from drought, and mosaic and leaf-roll could not be observed were either present. The cultural conditions were good, but the growth of the vines had been checked by the continued dry weather.

Ten days were occupied in inspecting Chili Garnets in Nova Scotia. Below is given the number of fields inspected and other information.

District	Fields	Total acres	Acres accepted	Acres condemned	Average percentage of leaf-roll in fields accepted
Masstown	10	23½	21½	2	1.3
Windsor	8	8½	2½	6	.7
Cornwallis	33	87	63	24	1.3
Grand Pre	1	1	1	0	.7
Clifton	49	80	74	6	.6
Totals	101	200	162	38	.9

The fields were inspected and scored by Mr. McCulloch and the writer for leaf-roll, black leg, rhizoctonia, presence of foreign varieties and growth. In most cases cultural conditions were good, and weather conditions considered, the vines showed large growth in the majority of cases, but continued dry weather reduced the yield seriously, and in the end sufficient seed was not available for Bermuda..

By seed selection, isolation, early roguing, and change of seed where necessary, commercial freedom from leaf-roll can be secured and maintained in Chili Garnets grown in any district in Nova Scotia. Generally speaking, the growers are more or less keen to grow good seed, but few are familiar with the conditions governing certified seed production. As the table above shows, the average area of the fields under seed potatoes was less than two acres. It is desirable that larger fields should be planted by fewer men, thus making instruction, supervision and inspection closer and more frequent.

In a previous part of this report is given the strains of Bliss Triumps under cultivation at the Station. All these strains were planted elsewhere in the Colony, and were under frequent observation. A statement of the behaviour of the strains is now presented.

(1) LONG ISLAND, NEW YORK. Leaf-roll infestation ran from less than 1 per cent to nearly 60 per cent, and in the majority of cases was less than 5 per cent. The very high percentage of infestation, 16 per cent to nearly 60 per cent, observed in a few fields can be accounted for only by the infection in Long Island from badly diseased Wisconsin potatoes, for in the majority of cases the poor seed was from the district in which Wisconsin seed was planted. Mosaic ran from 8 per cent to 25 per cent at the Station. The percentage of infestation fluctuated greatly, and one field containing 40 per cent of extreme type was observed. In vigour of growth the strains from Long Island were inferior to those from both Wisconsin and New Brunswick, and were more seriously injured by wind, and were less resistant to early blight than were either of the other two named.

(2) New Brunswick. Both strains of the New Brunswick seed, the original and that grown from the J. W. Smith (Wisconsin) strain, gave a good account of themselves. There was almost absolute freedom from both leaf-roll and mosaic, and in vigour of vine the strain was second only to J. W. Smith's, strain obtained direct but is not sufficiently early for general planting, and the same objection holds good regarding the four strains which follow.

(3) WISCONSIN (a) J. W. Smith's strain. This strain lived up to its reputation and is one of the best strains of Triumphs in existence to-day. The vine growth was exceptionally good, and both leaf-roll and mosaic were absent.

(b) SUNSET FARM. This strain was received too late for a fair test, nor had it been dug sufficiently early to provide the necessary resting period. In respect to leaf-roll and mosaic the strain was far superior to previous importations from Sunset Farm. Leaf-roll was observed, but there was practical freedom, and mosaic averaged 10 per cent which included many plants of the extreme dwarfed type.

(4) BATAVIA, NEW YORK. Like the Sunset Farm strain, this was received too late for a reliable test. The plants were vigorous and stocky. Infestation of leaf-roll and mosaic averaged 1 per cent and 2 per cent respectively.

(5) BUSHNELL, NEBRASKA. This also was received too late for a reliable test. The plants were vigorous in growth, but scarcely equal to the Batavia strain. Leaf-roll was observed, and mosaic averaged 6.5 per cent.

It is evident in the light of this year's tests, that there exist strains of Bliss Triumphs superior in vigour and freedom from disease to the strains now being grown in Long Island for Bermuda. Whether any of the strains under test, or others, can be procured sufficiently early to meet the requirements of the Bermuda fall seed trade remains to be proved, but the situation appears hopeful.

Every year the farmers of the Colony are subject, by the presence of disease and insect pests in potatoes and other crops, to severe loss, much of which is preventable by the adoption of more efficient control measures. The matter is one of grave importance and is dealt with by the Pathologist. Further loss often occurs, especially to potato growers, through lack of knowledge concerning market conditions, or failure to act on the knowledge furnished by the Department and otherwise. Almost invariably Triumph potatoes reach extreme prices in late March or early April, and too often it is not the farmer who is benefitted.

Before dismissing the potato, reference is made to the opinion recently expressed by Dr. Berthold Laufer, Curator of Anthropology, Field Museum of Natural History, Chicago, who says: "The potato entered this country not as surmised by de Candolle, through an alleged band of Spanish adventurers, but in a perfectly respectable manner from Bermuda, where it had been introduced some years previously from England. The History of the Bermudas states that on the 2nd December, 1621, Captain Nathaniel Butler, Governor of the Bermudas, sent from St. Georges's in the Somer Islands to the Governor of Virginia two large cedar chests 'wherein were fitted all such kinds and sorts of the country plants and fruits, as Virginia at that time and until then had not.'" The 'potato' was included in the list.

Green Vegetables

The results of the vegetable tests made at the Station during the year may be found in a previous part of this report. The registration of local seedmen has been approved by the Board, and will possibly be put into effect in July next. The measure is necessary for the protection of farmers and reliable seedsmen.

It is desirable to increase the kinds of vegetables shipped to New York. The returns made by the Inspector show that the bulk of the vegetables shipped consisted of beets and carrots. In the opinion of the Inspector, from information gathered in New York, increased quantities of beans, corn, kohl-rabi, peas and peppers, also cucumbers, egg-plant, okra, spinach, and tomato can generally be disposed of with profit. A study of the situation is being made. During the year under report moderately low prices were obtained for Bermuda vegetables in New York, and there existed transportation facilities in excess of shipments. It is evident that every reasonable effort should be made to improve the conditions under which Bermuda vegetables are sold in New York, and to extend her markets in all American and Canadian cities accesable to her through that port. The subject is again referred to under Marketing and Distribution.

Onions

In the report for 1920 considerable space was given to the former Director's report on his visit to the Canary Islands to enquire into the onion seed industry with the object of securing, if

possible, an earlier maturing strain free from admixture of red and pink-skinned bulbs. During the year under report the following recommendations made by the former Director have been adopted and to a limited extent acted on.

(1) Seed should be purchased in the Canaries from selected firms only, and the purchase of seed through London or other indirect sources should be prohibited.

(2) A full description of the desirable type of onion should be forwarded to the selected seedmen, and an arrangement entered into with them for the supply of improved seed.

(3) Importers of onion seed should be required to forward to the Director for test representative samples from every case of seed imported.

(4) The results of the tests should be made known to the importers in Bermuda and the exporters in the Canary Islands.

(5) Importers of seed should be registered.

The proposals above named were made known to the local importers who expressed themselves satisfied with the decision of the Board. Both of the selected firms in Teneriffe have intimated their willingness to develop a strain suitable to this Colony's requirements.

Under the provisions of the Agricultural, Department Act 1921, onions exported to the West Indies are subject to inspection and it is expected that this will tend to increase their sale in those Islands. The extension of Bermuda's markets, especially for onions, in the West Indies and Canada is treated of elsewhere in this report.

Improvement of Lily Bulbs

The increased interest that has lately been exhibited in the improvement of lily bulbs has been greatly stimulated by the presence in the Colony of Prof. Whetzel, who, as Pathologist, has been actively engaged in studying the diseases of this crop, and instructing the growers in methods of control. A limited number of growers have improved and maintained the quality of their bulbs by selection, rouging and rotation, and it is only by such methods and the systematic control of disease by spraying and dusting that reliable bulbs can be produced. The experience of these few growers is sufficient evidence that bulbs will not 'run out' if properly cared for.

There are indications that there exists an increased demand in the United States for bulbs of first quality, at the Toronto Exhibition the Board's representative was questioned concerning bulbs and other nursery stock, and enquires have been made in England with the object of re-establishing that market in which no bulbs have been sold since 1914. The variety of lily (L. longiflorum var. Harrisii) under cultivation here possesses the valu-

able characteristics of earliness and profusion of bloom, and the improvement and propagation of this variety is likely to give greater profit than will the importation of other varieties. Under the provisions of the Plant and Bulb Diseases and Pests Act, 1921, the importation of all types of Lilium longiflorum is now prohibited.

Fruit

Previous to the purchase of Montrose there was no suitable land at the Station available for growing and testing fruit with the view of determining what varieties are best suited to Bermuda. Suitable land is now available in limited area, and the experimental planting of fruit trees is contemplated. The prevalence of pests and diseases has heretofore been an important factor in restricting the cultivation of fruit in Bermuda, and it is anticipated that the investigations of the Pathologist will lead to their satisfactory control.

The absence of fruit in the Colony is most frequently complained of by those in position to import and test varieties, and it does not appear reasonable that they should wait—Micawber like—for something to turn up in the shape of complete knowledge on the part of the Department as to suitable varieties and best cultural methods. It is suggested that land owners should share with the Department some of the burden of experimentation, for the greater the number of experimenters, the earlier will definite knowledge be secured. It appears not improbable that a very extensive list of fruits may be introduced and cultivated in these Islands, for the behaviour of individual trees supports this view. Among those fruits whose experimental cultivation is recommended are the avocado, the mango and its lesser-known relatives; the annonaceous fruits, such as the sugar-apple and cherimoya; relatives of the loquat and the guava; the sapotaceous group, which includes the sapodilla; and most valuable of all—the citrus fruits. The field is an interesting and extensive one.

Horticulture

Perhaps some explanation is required for the Department's alleged neglect to promote horticulture, landscape gardening and other of the more refined aspects of all-embracing agriculture. The position of the critics is not well taken, for when Rome burns only a Nero fiddles. In the past(and it is to be remembered that more than half of the life of the Department has been lived through the Great War—there have been presented for solution many problems of vital importance to the agricultural community, at times to the Colony at large, and the Department, always understaffed, has rightly given to these matters first attention to the neglect of horticulture. Few of these problems are yet satisfactorily disposed of, but it is realized that a beginning must be made, and more attention paid to gardening and to the claims of those not intimately associated with farming.

The addition of eleven acres of land to the Station, and the settlement of future site, make it possible to devote more space and thought to the cultivation of ornamental plants, the introduction and testing of new exotics, and the propagation of well-tried kinds for distribution and exchange. The ornamental plants at the Station are now being identified preparatory to labelling, and more attention has been given to their care. The planting and care of trees on the roadsides, now the task of the Department of Public Works, more properly belongs to the Department of Agriculture. Special attention should be given not only to the care of the immediate roadsides, but to the countryside in sight of the roads, and in a sense the property of all who have eyes to see and souls to appreciate. Another important duty which should not be overlooked is the preservation of endemic plants, some of which are already on the verge of extinction.

Live Stock

In a former part of this report reference was made to the purchase of Guernsey cattle. This action on the part of the Board will result, it is hoped, in greater interest being taken in the breeding of better live stock, and increased attention being given to their care and feeding. Of recent years much improvement has been effected in dairy stock; this was evidenced by the animals shown at the Corn Show in 1918, but more remains to be done. Many very inferior bulls still stand for service, and there are yet a few cows in the Colony whose milk records would not do credit to well-bred goats. Very few pure bred pigs are kept, poultry has declined in both quality and numbers since 1914, and little has been done to improve goats. The conditions under which many domestis animals, especially hogs, are kept are disgraceful, and the production of certified milk, though less the duty of the Department of Agriculture than that of the General Board of Health, is correlated with the improvement of dairy stock. To further stimulate interest in better dairy animals it is proposed to organize a dairy cattle club, and it is hoped that future reference to live stock will be less apologetic than heretofore.

Due in large measure to the excellent supervision by the Government Veterinary Officer, whose report is attached, no serious outbreak of contagious or infectious animal disease has occured. Influenza was prevalent during the latter part of the year, having been introduced by imported horses. As the disease was not an infectious one within the meaning of the Animal Diseases Act, since repealed, adequate control was not possible. This will be corrected by new regulations now being drafted under the Agricultural Department Act, 1921.

Committee to Washington

Acting on information received from private sources, the Board at a meeting held on 20th December, 1920, considered it advisable to send a committee to Washington to make representation on behalf of the agricultural interests of the Colony in view of

contemplated changes in the United States plant quarantine regulations and import tariff. Wor. T. H. H. Outerbridge, J. P., M.C.P., and the Director were the committee appointed, and were accompanied by W. H. Allen, Esq., and J. W. H. Trott, Esq., who had been selected by the shippers of Bermuda produce. The committee reached Washington on 26th December, and were most kindly received at the British Embassy and by the Acting Secretary of State, Mr. Norman R. Davis. On the advice of His Excellency the Right Honourable Sir Auckland Geddes; K. C. B., Ambassador, the Committee did not ask to appear before the House Ways and Means Committee, but arranged that representation should be made by one or more New York receivers of Bermuda produce. Mr. Joseph E. Reid of Messrs. W. J. & S. H Davenport, consented to appear, and ably presented the Colony's case. No change, however, was made in Bermuda's favour in the provisions of the Fordney Emergency Tariff Bill, which came into operation on 27th May, 1921, and imposed a duty of twenty-five cents per bushel of potatoes, and of forty cents per bushel of onions. The Republican permanent tariff had not become effective at the close of the year under report; this measure will, if put into effect, change the basis of valuation for duty, and increase the duties on green vegetables. The changes effected in the plant quarantine regulations did not affect Bermuda.

On its return on 10th January, 1921, the committee reported to the Board, and made certain recommendations which were adopted and forwarded to the Honourable House of Assembly, where they failed to meet with approval. In making its recommendations the committee recognized the intimate trade relations between the Colony and the United States, the dependence of the former on the latter for markets for her agricultural products, and the negligible quantity exported to America when compared with that country' production. Briefly, the recommendation submitted to and approved by the Board was the exemption from import duty of American goods of approximate value in event of the United States agreeing to admit the Colony's agricultural products free of duty.

Bermuda's Agricultural Exhibit at Toronto

For the first time the Colony was represented in 1921 at the Canadian National Exhibition. The agricultural exhibits were prepared by the Second Assistant who also attended the Exhibition, and whose report may be found on another page. A Bermuda exhibit for Toronto was in course of preparation in 1914, but was not exhibited because of the outbreak of the Great War. Now that the inital step has been taken, it is hoped that the Colony will be represented annually.

Marketing and Distribution

The most important duty of the Board and Department is in relation to the sale of farm products. In October, 1916, His Excellency, Sir George M. Bullock, appointed an Agricultural Commis-

sion to enquire into and report as early as practicable on (1) the economic position of the farmer, (2) the manner in which he obtains credit, (3) the marketing and distribution of crops, (4) the practicability of devising a suitable credit system, and (5) the advantages of co-operation. The Commission has not yet reported, but some benefits have resulted from its appointment, among which is the presence of a government representative in New York during part of the market season. In the year under report Mr. G. E. Winter, Inspector of Green Vegetables, made four trips to New York, and remained there seventy-one days in all. There is ample evidence that the representative, by coming into personal contact with the receivers of produce and the steamship officials responsible for its transport and discharge, has been able to bring about conditions more favourable to Bermuda farmers. Mr. Winter is extremely interested in his work, and discharged his duties very efficiently and faithfully. Frequent cable advices and the amendment of the acts and regulations dealing with the inspection of produce and green vegetables have resulted, inter alia, in the amalgamation of the two services, and the standardization of grades and of some containers, the latter not to become effective until next season. This much has been accomplished, much more remains to be done.

Turning first to matters at home, it is evident that a reduction in the local shippers of produce is desirable. The number of those who now farm under the shed is excessive, and includes some who lack business experience and acumen, which lack more often causes loss to their clients than to themselves. Six to eight reliable local firms with good connections in New York would be sufficient. The licensing and bonding of local shippers or commission merchants has been under consideration for some time, and is again recommended. The former Director recommended the publication of sales returns from the various New York receivers for the information of farmers and shippers. The local sale of produce intended for the New York market should be discouraged. The practice of selling on Front Street part or the whole of a season's crop at a prearranged price is, in the main, disadvantageous to farmers, and brings in its wake many evils. The registration of a Bermuda trade-mark, and the systematic advertising of Bermuda's agricultural products are matters which have been frequently discussed, but on which no action has been taken. The improvement of labour conditions, another prolific source of discussion, is essential to the future prosperity of Bermuda farming. The establishment of a local market should receive attention.

During the year several conferences were held regarding freight rates to New York. As a result a substantial reduction was secured in the rates on agricultural products, though those now in force are still much above those in effect previous to the war. Marked improvement has been effected in the manner in which produce is handled in transit, but increased competition demands greater care in order that produce, and especially green vegetables, may be delivered in New York in attractive condition.

Bermuda is favourably placed with regard to New York, being distant by water only forty-eight hours, and for many years in this market has been sold ninety-five per cent of her exports. No where else on the American continent is there another market —with the possible exception of San Francisco—in which such prices can be obtained. Local agriculture has been developed with the object of meeting the requirements of this market, and sales effected elsewhere have been more or less accidental. Loss of or serious dimunition in our export trade to New York would bring about a condition extremely difficult to deal with, for there is no alternative industry or immediate market to give relief. The conditions under which produce is sold in that market, should be improved, and other subsidiary markets developed. Measured by any other standard than her own, the Colony's export trade is insignificant, yet to her it is of vital importance.

Local farming interests have been agitated for some time by the possibility of further increased duties being placed on Bermuda produce by the United States. Whether these fears are realized in the immediate or remote future, the danger is always present, unless removed by action on the part of the Colony. The United States now extends to Bermuda many concessions, for example, potatoes may be imported from Bermuda free of any restrictions whatsoever, the importation of potatoes in second-hand barrels and of lily bulbs in unsterilized packing is permitted. Is it unreasonable to assume that further concession may be obtained? It is difficult, perhaps, for Bermudians to comprehend the tiny proportions of our exports compared with production in the United States, nor are the Island's products "dumped" in the States, nor are they to be included among the low-priced foreign goods, the products of cheap labour, the importation of which would reduce the price of American-grown produce. On the contrary, our produce, as a rule, costs more to produce and sells in advance of domestic, and thus strengthens the market, if its influence is at all felt. The innocuous effect of our produce on domestic is the more apparent when one considers the season in which it is marketed. Take for example, our potatoes, which are sold as new crop in the first five months of the year; according to official figures, but four per cent of the domestic new crop is moved within that period.

Among the improvements which should be effected in the marketing of Bermuda products in New York, the following present themselves for consideration and action; a return, if practicable, to Pier 47 or its neighbourhood, as the place of discharge, because of its advantageous position in relation to the receivers' stores; a reduction in the number of receivers, now more than twenty, thereby eliminating the least satisfactory and reducing price-cutting; trials of other methods of sale, such as by public auction; and an increase in sales in markets outside of New York.

The Dominion of Canada at present imports directly one per cent of the Colony's exported crop. The evidence regarding the quantity of Bermuda produce re-exported to Canada from the United States indicates that it is small. In 1917 the former Direc-

tor reported that visits to Toronto and some American cities nearer New York "show that only ridiculously small quantities of Bermuda produce find their way to these markets." According to government statistics issued by the United States, in the first ten months of 1920 that country imported 1,653,480 bushels of onions (81,357 bushels were imported from Bermuda during the year), and re-exported to all countries only 10,333 bushels. As a potential purchaser of Bermuda produce the Dominion should be carefully studied, and every reasonable effort made to develop markets in that country. Previous to the year under report no steps had been taken to bring to the notice of Canada the winter-grown vegetables of Bermuda. At Toronto a start was this year made. It is probable that Canada will be more interested in onions than in other vegetables, and special attention should be given to stimulating their sale. When in the Maritime Provinces this summer inquiries were made regarding the possibility of increasing the sale of Bermuda vegetables, and on every hand indications were that Bermuda onions were popular and in good demand in Eastern Canada, while there appeared to be no demand for potatoes and green vegetables.

Inadequate steamship accomodation to Halifax and St. John is now the limiting factor with regard to the Canadian eastern seaboard. For points west of Montreal by way of New York is the cheapest and most direct route, for at the railroad rates which obtained this summer, Nova Scotia farmers found it cheaper to ship produce to New York by schooners and thence by rail to Montreal and points west of that city than all the way by rail. Measured in hours New York is but little more than half the distance from Bermuda than is Halifax or St John, and the first- named port is this Colony's entrance to all Canada other than the eastern coast. Railway rates from New York to Montreal and Toronto were ascertained last winter, and the following rates were then in force. On potatoes, onions and other vegetables, in carload lots, to Montreal 46 cents per 100 lbs. and to Toronto 47 1-2 cents. For protecting the freight against frost the following charges were made; for hay, straw and sawdust for packing, $2.00 per 100 lbs; for lining with paper, $3.75 to $5.50 per car. Additional charges were made for heated cars. A car-load is for potatoes 36,000 lbs., onions 24,000 lbs., and for other vegetables about 20,000 lbs. The approximate time from New York to Montreal or Toronto is four days according to Mr. L. M. Sonders, the General Eastern Freight Agent of the New York Central Lines. Practically no bulbs or other nursery stock is exported to Canada. The Colony's exhibit of nursery stock at Toronto attracted much attention, and should result in trade. Very large quantities of nursery stock could be grown here on land otherwise unfit for cultivation, if markets existed for it. As the plant quarantine regulations now in force in the United States prohibit the entry of but a limited quantity, an outlet should be looked for in Canada.

During the last twelve years the West Indies have taken four per cent of Bermuda's agricultural exports. The trade has been very erratic; for the value of onions exported has during that period fluctuated between £2,000 and £22,000, and potatoes between £200 and £8,940. It is evident that price and demand

are not the only contributing factors. The West Indies are valuable adjuncts to the New York market, because goods of lower grade can there be disposed of. The methods of selling are rather unsatisfactory, and it can be safely assumed that a larger market could be developed if proper attention were given to the matter. Again, as in the case of exports to Canada via Halifax and St. John adequate transportation facilities to the West Indies do not at present exist.

The Colony's exports to Great Britain have always, and naturally, been insignificant, and represent but half of one per cent of the total agricultural exports. Lily bulbs and arrowroot have been the only products exported in the past, and these have declined of late. During the year under report inquiries were made regarding the demand in England for the commodities named above, and a trial shipment of early potatoes will be made. If direct communication existed there is no doubt that a trade in nursery stock, potatoes and other early vegetables could be established.

The marketing and distributing of our crops has been dealt with at some length, because its importance cannot be over estimated. The hazards of farming are many, and all **unnecessary** risks and losses in selling should be eliminated. The business of farming must be established, or land—within forty-eight hours of one of the world's largest markets—will go out of cultivation. Some ways in which the Bermuda farmer can be helped have been indicated, others will suggest themselves. Grandmotherly legislature or supervision is not advocated, but whatever will have the efect of giving to our farmers a more reasonable share of the consumer's dollar, and making them more independent and prosperous should receive careful consideration.

Educational Work

The educational work of the Department includes demonstration plantings at the Station, visits to farms, public meetings, publication of information in the local newspapers and in departmental bulletins, work among the Agricultural Clubs, and exhibits at local shows.

During the year under report the potato experiments were of interest to the limited number of farmers who viewed them, as were the legumes grown in the late summer, and the vegetable tests in the fall. All experimental plots are labelled, and it is hoped soon to have many of the trees and shrubs also labelled. Nearly three hundred visits were paid to farms by members of the staff. On these visits it is possible to personally advise farmers on the control of plant diseases and pests and other matters of equal importance.

Since the latter part of 1918 few public meetings were held, and some difficulty has been experienced this year in securing attendances equal to those of the past. Since 12th July, the date of the first, seven meetings have been held in Warwick, Devonshire,

Hamilton Parish, Southampton, Smiths, Sandys and St George's. The average attendance was thirty-one. In addition to these meetings the Director addressed the Bermuda Green Vegetable growers' Association, the Pembroke Arbor Society, and the growers of Chili Garnet potatoes at Old Barns, Nova Scotia; and the Pathologist addressed a meeting of lily growers and two meetings of the Garden Club. Both the Royal Gazette and Colonist Daily and the Mid-Ocean have accepted for publication items of general interest, which have been written chiefly by the Pathologist. No departmental publications have been issued other than the annual report for 1920.

The work among the Boys' and Girls' Agricultural Clubs continues, but there is need to reorganize and more closely supervise it. The corn exhibits were less numerous and of poorer quality than in former years, due largely to the absence of rain during the summer. The principal prizes awarded in the contests are the silver cups which are held one year and on which are engraved the winner's names. This year the cups are awarded as follows:

Cup presented by Honourable W. E. Jackson, C. M. G.
Marjorie Smith, St. George's Grammer School, St. George's.
For best ten ears of corn grown by a girl.

Cup presented by the Bermuda Green Vegetable Growers' Association.
Sidney Smith, St. George's Grammer School, St. George's.
For best ten ears of corn grown by a boy.

Cup presented by Honourable J. P. Hand, M. B. E.
Wyndham Barnes, Cedar Hill School, Southampton.
For largest yield of corn (109 lbs. in the ear from 1 gill of seed)

In addition to the cups, cash prizes to the value of £7 7 0 were awarded to forty-nine members of fourteen clubs. Special mention should be made of the uniformly good exhibits of the Cedar Hill School in Southampton. Since 1919 this Club has not failed to win one or more cups. The school with which the Club is associated is a small one, and great credit is due the members, Mrs. Louise F. Hayward the teacher, and Mr. W. A. Barnes, Southampton's representative on the Board, who has always taken a commendable interest in the Club.

Staff

Many additions to and changes in the staff have taken place during the year, which began with the Director seconded to another Department, and no other whole-time officer in existence.

Mr. E. A. McCallan, Director, having been relieved of the office of Acting Colonial Surveyor, assumed his duties on 1st February.

Prof. H. H. Whetzel, A. B., M. A., Head of the Department of Plant Pathology of the New York State College of Agriculture, Cornell University, Ithaca, was temporarily appointed to the Department as First Assistant for one year from June last. Prof. Whetzel arrived in Bermuda on 10th June, and at once began to investigate local plant diseases and pests and methods of control.

Mr. J. J. Outerbridge was appointed Second Assistant on 1st June. He very ably represented the Board and Department at the Bermuda booth at the Canadian National Exhibition, Toronto.

Dr. R. L. Tucker, V. S., Government Veterinary Officer, was instructed by the Board to select the dairy cattle, the purchase of which was authorized by the Appropriation Act of 1920. During his absence from the Colony his official duties were performed by Dr. F. W. E. Peniston, V. S.

Mr. E. G. Perinchief resigned the Clerkship to the Board at the close of the year on being promoted Junior Clerk, Colonial Secretary's Office, and was succeeded by Mr. G. L. Young, who has been appointed Clerk to the Director also, under the Civil Service Establishment Act, 1921. Mr. Young had been employed in the office for nearly five years previous to his appointment.

Mr. R. W. Browne, Inspector of Produce, died suddenly on 25th June. By his death the Department lost a most efficient inspector with many years experience in the inspection service. Mr. F. W. Williams, Assistant Inspector, was placed in charge on Mr. Browne's death, and carried out his duties satisfactorily until the close of the year.

Mr. G. E. Winter, Inspector of Green Vegetables, was absent from the Colony for several periods during the winter on special duty in connection with the supervision of chill-rooms and market investigations in New York. During his absence the inspection of green vegetables continued to be very satisfactory, performed under the direction of Mr. E. L. Adams, Assistant Inspector. The Inspector's report is attached.

Mr. C. V. S. Early, Foreman of the Station, discharged his duties well under unsatisfactory labour conditions.

Mr. S. E. A. McCallan, a student of the Ontario Agricultural College, was employed during the summer vacation in plant disease, pest control and similar work.

Mr. Otto Degener, a student of the Massachusetts State College of Agriculture, and Mr. M. E. Luther, a graduate of the Wisconsin State College of Agriculture, have given much valuable voluntary service to the Department. Mr. Degener worked continuously from the early part of July until mid-September in collecting plants for the herbarium, in oleander scale survey and other plant disease and pest control. Mr. Luther was in the Colony during the latter part of the year in connection with tests of Sunset Farm seed potatoes, and regularly reported instances of plant diseases and pests coming under his observation, as well as assisting occasionally in survey work. The Department is under obligation to both these young men.

Acknowledgement is made of the good work performed generally by the members of the staff during the year under report.

Special reference is made to the untiring energy and enthusiasm which Prof. Whetzel has displayed in the discharge of his duties. His report forms the most valuable section of this volume. In connection with Prof. Whetzel's temporary association with the Department, acknowledgement is made of the kindness of Dean A. R. Mann, B. S. A., M. A, of the New York State College of Agriculture, in loaning scientific apparatus.

Financial

The expenditure of £5,862—1—7 was authorized by the Appropriation Act of 1920, the Agricultural Department Act, 1921 (Purchase of Equipment), the Plant and Bulb Diseases and Pests Act, 1921, and Resolves 13 and 47 of 1921. Of this amount the sum of £5,488—15—2 was expended. The sum of £176—1—11 was received from sales of vegetables and other sources, and was reimbursed to the Treasury. Statements of the expenditure under the various sub-heads and sales will be found in Appendices A and B.

During the past nine years the expenditure by the Department (exclusive of salaries), and the receipt at the Station have been as follows:

Year	Expenditure	Receipts
1913	£2,274 5 2	£ 32 18 1
1914	3,042 2 3	32 14 0
1915	2,529 18 0	89 3 4
1916	2,497 19 2	163 18 10
1917	2,045 5 7	156 2 10
1918	2,051 8 0	376 3 4
1919	2,722 5 8	157 18 0
1920	3,128 6 6	209 4 6
1921	5,488 15 2	176 1 11

E. A. McCALLAN,

Director of Agriculture.

Agricultural Station, Bermuda,

6th February, 1922.

REPORT OF THE PATHOLOGIST FOR THE PERIOD JUNE 10TH TO DECEMBER 31ST 1921.

THE DIRECTOR OF AGRICULTURE,

I have the honour to submit the following report on insect pests and diseases of plants.

The plans of the work for the year contemplated, among other things, the following three chief lines of endeavour:

(1) A general survey to be consumated chiefly through the collection and indentification of the insects, fungi and related organisms occuring in the Islands, with special attention to those attacking plants.

(2) Investigations on the cause and control of the more important diseases and pests of plants.

(3) Instructing the people in methods for the control of these diseases and pests.

The progress made along these lines is here briefly presented together with a consideration of the more important diseases and pests observed and studied during the seven months covered by this report.

Collections

The collecting of fungi and insects has been prosecuted as vigorously as the other phases of the programme have permitted, but only a good start has been made. The collections to December 31st have yielded the following estimated number of forms:

(1) Bacteria causing diseases of plants, five species, of which **Actinomyces chromogenus,** causing potato scab, **Bacterium tunefaciens**, the crown gall organism, and **Bacterium campestre,** responsible for the black rot in cabbage, turnips and cauliflower, are the most important.

(2) Myxomycetes or slime moulds, twenty-five species. None of the parasitic species of these slime fungi have thus far been found in Bermuda, although **Plasmodiophora brassicae**, the cause of club rot in cabbage and other cruciferous plants, and **Spongospora subterranea**, the pathogene of powdery scab of potatoes, might be expected to occur here. The species collected are all saprophytes. They assist in the decomposition of plant debris and its reduction to humus. These minute but very beautiful plants commonly escape observation. No special attempt to collect them in Bermuda has heretofore been made.

(3) Fungi, of which approximately 200 species have been taken. Of these nearly one half are parasites on wild and cultivated plants. Some of these are the cause of destructive diseases which

result in serious losses to the crops of the Islands. The number collected during these seven months is nearly twice that previously known for Bermuda. The collections for the next five months should double the number already taken.

(4) Insects, of which over 100 separate collections have been made, are chiefly species occurring as pests on the wild and cultivated plants. Some are among the important factors in the injury and destruction of crops and ornamental plants in the Colony.

Arrangements have been made with experts in the United States, England and other countries for the identification of the myxomycetes, fungi, bacteria and insects collected. The number of scientists already enlisted in the identification of material is over fifteen. Not only are the men identifying the forms sent them, but they are also giving generously of their time and knowledge in assisting with information on the nature and control of pathogenes and pests. We are especially indebted for such co-operation to the scientific men at Cornell University, the United States Department of Agriculture, New York Botanical Gardens, Indiana Agricultural Experiment Station, Florida Plant Board and Kew Gardens, England, as well as to a number of scientific workers in other institutions.

Twelve sets of the fungi of Bermuda are being made up for deposit in the principal museums and institutions of the world. These sets will serve a most useful purpose in connection with the identification of future collections which may be made by workers in these Islands. One set will be deposited at the Agricultural Station.

Considering the limited amount of time which it has been possible to give to this phase of the work, very satisfactory progress has been made.

Special Investigations

Much time has been devoted to the study and investigation of some of the more important diseases and pests of plants which are found in the Colony. Those to which special consideration has been given are: the oleander scale, the stump rot and the black scale of Easter lilies, the Septoria blight and the black heart of celery, the banana borer, the shoot rot of the bamboo, the early blight of potatoes, a mite (?) disease of seed potatoes and several other diseases and pests of some economic importance.

The chief facts discovered in these investigations are set forth below along with observation and suggestions respecting other diseases and pests.

Instructing the Public

Information on plant diseases and pests has been presented to the public through several channels, the chief of which may be grouped as follows:

(1) Public lectures and talks, given before farmers' meetings in nearly every parish, to the number of seven. Six demonstrations on the nature of the oleander scale were made in the schools. A special conference with lily growers on the diseases of lilies was held in Hamilton.

(2) Spraying demonstrations on the control of the oleander scale were made along the public roads in several of the parishes to convince the public of the efficiency of this means of combatting the pest.

(3) Dusting demonstrations for the control of the potato blight were conducted; one at the Agricultural Station and two on farms, in the parishes of Warwick and Southampton. The heavy winds of early December destroyed the foliage in these fields and largely nullified the results.

(4) The following news articles were prepared and appeared in the local press at intervals:

Oleander Scale Survey.
To Control Oleander Scale.
Questions on Oleander Scale Answered.
Two Pests of the Yellow Cosmos.
Spraying Loquats.
Oleander Spraying.
The Septoria Blight of Tomatoes.
Present Status of Oleander Spraying.
Oleander Scale on Potatoes.
Plants Attacked by Oleander Scale in Bermuda.
A New Scale on the Palmetto.

(5) Personal visits to farms and properties to look for pests and diseases and to consult with the growers on methods of control have consumed much time. An average of about ten days each month has been thus spent in the field with a total of over 150 visits to farms and properties during the seven months.

(6) Monthly reports setting forth the work accomplished and including detailed statements respecting the more important diseases and pests observed and studied during the month have been prepared and presented to the Board. These reports constitute a body of observations, facts and information which may be drawn upon in succeeding years for instructing the growers at timely opportunities on the control of the diseases and pests of their crops. They will also serve as a basis for further studies and investigations which may be undertaken in the future along these lines.

Other Activities

Some time, especially during the summer months, was devoted to the collection and identification of the flowering plants, many of which are as yet unrepresented in the Station herbarium. Mr. Alan McCallan assisted with this work throughout the sum-

mer, as did also Mr. Otto Degener, a student from the Massachusetts Agricultural College, who early in July volunteered his services. A goodly number of specimens were thus added to the collections, especially species of weeds, few of which were to be found in the herbarium.

A number of days were devoted to surveying for the oleander scale. During the summer a preliminary survey of the Islands was made to determine something regarding the extent and severity of the infestation. In this work the young men mentioned above gave much assistance. After the power sprayers arrived in November a detailed survey of Long Bird, St. George's and Somerset Islands was made to locate infested oleanders and mark them for spraying. As every hedge and bush over these Islands had to be examined, much time of the Pathologist as well as other members of the staff was consumed in the work.

The inspection of lily bulbs for export, of potatoes imported for seed and of bulbs and plants coming into the Islands by post has required considerable time and attention. These inspections by the Pathologist were solely for the purpose of intercepting dangerous diseases and pests. Nothing of an especially dangerous character was detected. Spanish iris bulbs were almost uniformly badly rotted or infested with mites. Rotted and infested bulbs were destroyed.

Imported seed potatoes of both Bliss and Garnet varieties were notably free from the late blight fungus (**Phytophthora infestans**), only one diseased tuber having been found. This was doubtless due to the very dry season in both eastern Canada and Long Island, where Bermuda seed potatoes are grown. Scab was rather common, on both the Bliss and Garnets, some barrels of which showed fifty per cent or more of the tubers affected. This was apparently reflected in the Bliss crop which was generally more or less scabby. Garnet seed showed almost uniformly a small percentage of rot due to species of Fusarium. This was due doubtless to the dry hot weather which had prevailed in the Sections where they had been grown. In some lots this rot developed seriously in storage, as few growers followed the recommendations that the tubers be sorted immediately and stored in crates. Most growers stored them in the closed barrels in which they were received.

Plans for the next five months

The work of the remaining five months of my stay is to be a continuation of the lines of endeavour described above. A report covering the principal diseases and pests observed and studied during this period will be submitted, constituting a continuation of that presented below. In addition a complete annoted list of the slime moulds, fungi, phytopathogenic bacteria and insects collected during the entire twelve months and including those reported from the Islands by previous collectors is in preparation and will

be eventually submitted. Many of the species collected will require additional study before they can be properly identified.

This list will constitute a most valuable catalogue of these forms occuring in Bermuda. It will be invaluable to future workers along these lines in the Islands. It may well appear as a special report from the Department of Agriculture.

Diseases and Pests of Plants

The plants of Bermuda appear to be afflicted, in the main, with the common diseases and pests to which these plants are subject in other countries where they occur. All the cultivated plants and most of the weeds have been introduced by man, if the cedar and palmetto be excepted. Their diseases and pests have been brought in with them at one time or another.

Diseases of plants are caused chiefly by fungi and bacteria. These are for the most part microscopic plants. Many, though by no means all, fungi and bacteria live as parasites on green plants, from which they derive their food and in which they cause disease. The greater number of these organisms live on dead animal and plant debris, causing its disintegration and return to the soil and air in the form of compounds which plants may again use for food. The great number therefore of the fungi and bacteria are not only harmless, but actually necessary to agriculture. A few insects and other animals cause diseases in plants. Of the large number of insects that do attack plants, most of them cause what is commonly spoken of as injuries. They either eat away parts or all of the plant or suck out the sap leaving the infested leaves or other organs to dry and die.

By far the greatest number of plant diseases in Bermuda as elsewhere, are caused by fungi. A few bacterial diseases, like crown gall and black rot of cabbage, kale and turnips, have been observed. Another class of diseases, known as mosaics, also effect certain crops and weeds growing in the Islands. Of these the best known to the Bermuda farmer is the potato mosaic. Broad beans, snap beans and tomatoes also suffer here from mosaic diseases. The causal agents in mosaic diseases are now generally believed to be living organisms of some sort, not yet detected by investigators. Mosaic diseases are infectious just as are those produced by fungi and bacteria. Their most distinctive characteristic is the light and dark green mottling of the foliage of affected plants.

The relation of weather to diseases in plants appears most difficult for the grower correctly to understand and appreciate. This is due to the age old inherited superstition or belief "that weather causes disease." Until the farmer or gardener can completely disabuse his mind of this fallacy, he cannot hope to understand the true nature of disease in his crops, and profit fully from our modern knowledge of them and their control. The relation of weather to insect depredations, on the other hand, is readily understood.

Dry warm weather favours most insects, cold wet weather reduces their activities. A good illustration of the latter is the almost complete absence of fruit fly in loquats this season.

Weather bears the same kind of relation to an epidemic of disease that it does to the production of a bumper crop of potatoes, for example. No sane grower will contend that weather is the cause of a potato plant. A potato plant is caused or produced by a seed tuber, or a piece of one, placed in the soil. Rain, sunshine, fertilizer and many other factors influence the growth of the plant and the production of a crop, but the first cause is the seed piece. Weather, fertilizer, cultivation, all the other factors together or separately cannot produce a potato crop unless seed tubers are first put into the soil. Just so must the spores, the germs or seeds, of the late blight fungus, **Phytophthora infestans,** be present in the field before the disease can develop and sweep away the foliage and rot the tubers. Weather greatly modifies the severity of the attack of the fungus just as it does the growth and development of the potato. If the weather be moist and cloudy with little wind and the proper temperature, the fungus, if present, will thrive and devastate the fields. On the other hand, no matter how favourably the weather, no blight will appear if the spores of the fungus be not present. This fundamental fact applies to all germ diseases of plants, and they are with few exceptions all caused by germs. To understand and accept this idea is the beginning of wisdom in the knowledge and control of plant diseases here in Bermuda as elsewhere.

The losses from diseases in Bermuda crops are probably higher than in most other countries. This is due to a combination of many factors favouring the disease producing fungi and bacteria here. Perhaps the most important of these factors is the continuous growing season. There is no winter to freeze them out or dry season to kill them off; they flourish, more or less, throughout the year. Winter here, the chief cropping season, is cool and usually rainy, two factors most favourable to nearly all disease producing organisms. The summers are hot and fairly dry, so that insects flourish and take heavy toll of such crops as are grown.

In every crop thus far examined on this point, the facts gathered have indicated appalling losses. The yields now commonly obtained are evidently regarded by the farmers as approximately all that is to be expected, a good average of what soil and weather will produce. The fact is, they are rarely more than half what would be produced in the case of most crops, were it not for diseases and pests. Wind cause the Bermuda farmer heavy losses in his potato crop at times, but it is by no means the most destructive factor even in that crop. Early blight alone reduced the potato crop approximately as much as did the winds of early December, yet scarcely a farmer in the Colony knows the disease or will admit its damages.

A single disease, the stump rot, destroyed fully 25 per cent of the lilies in the Islands before January 1st, 1922. This is a conser-

vative estimate based upon careful counts in most of the lily fields. The ravages of this disease are not yet completed, but it will whittle off another 10 per cent or so before the crop is harvested. The black scale disease affects not less than seventy-five per cent of all the lilies now growing in the Islands. The individual plants show varying degrees of susceptibility, from those that die out early to those that die or "mature" prematurely toward the end of the season. This black scale, aside from its other insidious effects on the lily industry of the Islands, reduces the yield not less than twenty-five to fifty per cent every year and is almost certainly the chief cause of the so called "running out" of stock that has put so many lily growers out of the business in the past. This loss can be almost completely eliminated in two or three years by a simple method of selection. There is already striking evidence in the test plots on at least two farms that the method is effective, and the remarkable maintenance and improvement of the same stock through many years by Messrs H. E. D. and H. R. T. Smith on St. David's Island is sufficient proof that stock does not degenerate when the diseased and susceptible plants are destroyed together with the stock which they produce.

Approximately 50 per cent of the bamboo canes that have started during the past three years have been rotted off by a disease which attacks the growing tip just before the sucker elongates. The disease destroyed seventy per cent of the new suckers produced in 1922. If the rate of loss of the last three years continues, bamboos, will have largely disappeared from these Islands by 1925.

In almost any crop to which one turns, losses from diseases and pests, heavy beyond expectation, are encountered. It seems quite conservative to say that not less than fifty per cent of many crops, probably most of them, are lost annually in Bermuda from diseases and pests. Of the two, diseases are the most serious in several respects.

The principles on which the control of plant diseases and pests are based—are four in number, viz., exclusion, eradication, protection and immunization.

Much might have been done in the past to exclude some of the more serious diseases and many of the destructive pests. Something may yet be accomplished by stringent quarantines against plant importations from the West Indies, the chief source of most of the destructive invaders in the past. From these Islands came the purple scale on the citrus, the peach scale now destroying the oleanders, the banana borer and many others. The banana wilt is now present in some of the West Indies and constantly threatens the banana industry here. The quarantine laid against the importation of bananas by the Colony this year should be extended to sweet potatoes, ornamentals, especially palms, and the like. The importation of ornamentals from the West Indies and other tropical countries is a constant source of new diseases and pests, and should be prohibited, unless the Colony prefers to spend thousands

of pounds fighting some of them every now and then. The oleander scale is a West Indian gift which Bermudians should never forget.

Eradication, as here used, does not mean the complete eradication of an insect or fungus throughout the Islands after it has become well established. This is almost without exception impossible, at least impracticable, as witness the attempt here some years ago to get rid of the fruit fly by the destruction of all fruit trees throughout the Colony. By eradication is meant the destruction of a given pest or disease from some crop or limited area, for the crop season. Most insects are to be controlled in this way; by an arsenical poison sprayed or dusted on the plants infested with chewing insects; or by contact sprays such as lime-sulphur, miscible oils or tobacco extract applied to plants infested with sucking insects. Tobacco extract in dust form is now available for such use against soft bodied sucking bugs, such as plant lice for example

Few fungi expose themselves upon the living surface of their host plants, so that eradication can be effected. The powdery mildews are exceptions. They can be cleaned from such plants as the rose, papaw or avocado by dusting the leaves with sulphur. Potato tubers may be disinfected with a formaldehyde solution to destroy the scab germs on them before planting, and soil infested with the pink root of onions, or damping off fungi which destroy seedlings of many kinds, may be disinfected with steam or formaldehyde. Where such eradication measures can be employed they are very effective.

While insects are generally to be controlled by eradication measures, diseases for the most part are met by protecting the plants against the disease, including fungi. Spraying and dusting are the most common methods of protection. The fundamental thing to remember in attempting to protect plants against fungi and insects is to apply the fungicide or insecticide **before** these destroyers get on the plant. This is especially important in the case of fungi. Fungi are usually disseminated and infect their hosts during rainy weather. Spraying for disease should therefore be done just before, for insects usually just after, rains. Bordeaux mixture and lime-sulphur are the standard fungicides for spraying, but the strength of each varies with the disease to be controlled or the plant to be treated. Finely ground sulphur and copper lime dust are now available as very effective dust substitutes for the liquid fungicides. For protecting plants against insects, arsenic in some form, as arsenate of lead, arsenate of lime or paris green applied as a spray or in dust form is the standard poison. Details regarding kind, strength, methods of application and the proper times for making the applications of insecticides and fungicides are given for the different pests and diseases discussed below.

Immunization constitutes the most modern and the most satisfactory means of combatting diseases and pests where it can be

successfully employed. By immunization is meant the production of strains or varieties of cultivated plants which are not subject to the attacks of the destructive diseases or pests. This is now to be effected in one of two ways. The first method is by the discovery isolation and multiplication of immune or resistant individuals, some of which are usually to be found in every plant population. All healthy plants in a field attacked by disease are not necessarily resistant or immune, they may merely have escaped infection. Therefore individual plants selected because of apparent immunity, or the progeny of such plants, must be exposed for several seasons to attacks of the pathogene in order that the susceptible individuals may be detected and destroyed. Thus a strain or race of highly resistant or completely immune individuals can be gradually built up which will grow and flourish in localities where the destructive fungus or insect commonly flourished. This method of immunization is the easiest and most satisfactory. It may be employed by any intelligent grower on almost any annual crop. It is less satisfactory with fruit trees or other plants whose development extends over a period of years. It is now widely employed and has given marvelous results in many instances. The control of the black scale of lilies is to be readily effected, as indicated above, by this method. The second method of immunization is through the crossing of resistant individuals of undesirable races or varieties with susceptible varieties having other especially desirable qualities. This is, however, a tedious and difficult process requiring years of careful and painstaking work. It is scarcely adapted to the facilities and time of the average farmer, and is to be employed only by expert plant breeders with the necessary technical training.

In the following paragraphs are presented in alphabetical order some of the more important plants of the Islands, with a brief consideration under each of those diseases and pests of major importance which have come under our observation during the period from tenth June to thirty-first December, 1921.

Acalypha

CROWN GALL. The acalypha hedges of Bermuda are generally infected with this well known bacterial disease, the plant cancer. Galls or swellings of various sizes cover the crowns and trunks. The bacteria (**Bacterium tumefaciens**) which cause these galls are doubtless spread by the pruning knife. This plant seems to suffer but little from the disease, and its presence in hedges need give little concern.

Avocado

POWDERY MILDEW. This disease is universal in these Islands. It affects the leaves, causing a brown mottled effect. The leaves fall prematurely, compelling the tree to put out new foliage several times during the year. The infrequency of fruit on avocado trees in Bermuda may well be due to this continual defoliation constantly requiring the tree to produce new leaves so that it is thus unable to produce flowers and fruit.

The cause of this disease is a microscopic web-like fungus growth on the lower surface of the leaves. The fungus is one of the Erysiphaceae, but as it produces only the vegetative stage here its specific identity has not been determined.

RED SPIDER. This minute red mite was found severely infesting the leaves of avocado trees on the Station grounds in November. It lives on the under side of the leaves, sucking out the sap and causing the leaves to turn brown, giving them a burned appearance. Dusting with sulphur as for the powder mildew is very effective against red spider.

DIE BACK Many avocado trees show an excessive amount of dead limbs and tips of young shoots. The cause has not been determined. Such dead branches should be promptly removed and destroyed.

HEART ROT. Most large avocado trees are more or less affected with heart rot, caused by wood destroying fungi. These fungi gain entrance through the wounds made in pruning. Pruning is generally badly done in Bermuda. Stubs are commonly left which cannot heal over. Rot fungi become established and eventually invade the heart of the trunk or main limbs, thus weakening the tree and in time destroying it.

All cuts in pruning should be made close to and parallel with the trunk or limb from which the pruned branch is removed. The cut surface should be promptly coated with gas tar which should be renewed every year or two until the wound has completely healed.

Bamboo

SHOOT ROT. The large bamboo (**Bambus vulgaris**) is seriously threatened in Bermuda by a rot which destroys an inch or so of the tender growing tip just before it begins to elongate. Every planting examined has been found to be infested. The record of this disease is easily determined in a planting for three years back. Careful counts of diseased and healthy shoots made in nine widely separated plantings show totals as follows:

	1921	1920	1919	Total Canes
Canes started	272	593	602	1467
Canes diseased	187	371	165	723
Canes healthy	85	222	437	744
Per cent diseased	68.7	62.5	27.4	49.2

It is quite evident from this data that the percentage of diseased canes is increasing yearly; also that the total canes produced each year, both diseased and healthy, is rapidly decreasing. In other words the bamboo plantings are dying out. If the present rate of destruction continues the bamboo should have largely disappeared from these Islands by 1925.

The disease appears to be caused by a soil fungus, **Rhizoctonia,** species as yet undetermined. Investigations on the disease are

under way in the hope of finding some means of checking the ravages of the disease.

SCALE. There is at least one species of scale insect infesting bamboos in Bermuda. This scale, a species with fringed margins, is very abundant in some plantings, literally coating the canes and leaves. Spraying with oil sprays such as Scalecide should control this pest. While a dilution of 1 to 20 will probably kill the scale it may also injure the foliage. Trials will have to be made to determine the most effective strength compatable with safety to the leaves. If the young suckers and crowns are treated before the foliage develops and all old canes are cut and destroyed, it should be relatively simple to get rid of the pest in a planting.

Bananas

THE BORER. The most dangerous pest thus far discovered in bananas here is the borer or weevil, **Cosmopolitis sordidus,** (Ger) Chev. This is a large dark beetle with a blunt snout or probosis. The larvae of this beetle, large white grubs with brownish heads, tunnel through the base of the tree and down into the roots. They often kill young suckers and weaken old trees so that they fail to develop the fruit properly or are broken over by the gales.

This borer is a pest widespread throughout the tropics, in some countries of which its ravages are serious. In other places it seems to cause little loss. In the latter cases this is probably due to the presence of natural enemies which hold it in check.

This insect was doubtless brought into these Islands in banana suckers imported from the West Indies where the pest is common. It has already been found in three plantations in two parishes. A careful inspection of every banana planting in the Islands should be made to determine the extent and severity of the infestation. In this way only may the necessary evidence be obtained upon which to determine whether steps for its control ought to be undertaken.

It is sufficiently dangerous to warrant growers digging out and promptly destroying all infested trees. These should not be left in the plantation as the larvae in them will mature and go to trees nearby, thus spreading the infestation. Traps may be made of slices of the stems of freshly cut trees laid on the soil. The adult beetles will congregate under these to feed, and can then be easily collected and destroyed.

OTHER DISEASES AND PESTS. One species of scale (as yet undetermined) has been found sparingly on bananas. It does not appear to be dangerous.

Several diseases of obscure etiology have been observed, but with one exception do not appear to be of much economic importance. Bananas in Bermuda are remarkably healthy and free from diseases and pests. The chief danger to banana culture here lies in the possibility of the introduction of the Panama or wilt dis-

ease from the West Indies. We have already referred to this danger. Its introduction into the Islands would almost certainly mean the destruction of the crop throughout Bermuda and a soil infestation which would make banana growing in the future impossible. The quarantine on bananas from the West Indies should be maintained and strictly enforced.

Beets

WORMS. Leaf eating larvae of several moths, commonly called fire worms by the growers here, were serious in most beets early in the season. Thorough spraying or dusting with arsenate of lead or other arsenicals is very effective in putting a stop to their ravages. Considering the ease with which losses from these pests may be prevented, it is surprising that scarely any farmers attempt to control fire worms in their beets.

HEART ROT. A heart rot apparently due to a species of Rhizoctonia was observed in the beet plots at the Station. Only a few roots were affected.

Beans

ANTHRACNOSE. The anthracnose or pod spot of snap beans was observed in a garden in December. It is said to be frequently destructive. The fungus, **Colletotrichum lindemuthianum** which causes this disease is introduced into the crop with the seed. There is no satisfactory way of eliminating the disease from infected seed. If possible, seed guaranteed to be free from this disease should be purchased.

BLIGHT. This is a bacterial disease caused by Bacterium **phaseoli.** The blight causes dead areas in the leaves which shrivel and fall. Spots not unlike those produced by the anthracnose are produced on the pods and sometimes a sudden wilting of the entire plant occurs. Both snap and lima beans suffer severely from this disease. No satisfactory method of control is known except the planting of disease-free seed.

POWDERY MILDEW. Perhaps the most common and serious disease of beans in Bermuda is a powder mildew which seems to flourish at all seasons of the year. The leaves, stems and pods are covered with a white powdery mildew scarcely visible except on close scrutiny. The fungus, one of the Erysiphaceae, probably **Erysiphe polygoni,** grows upon the surface of all parts of the plant above ground slowly sapping its vitality. The leaves curl and roughen, yellow and die prematurely. The pods are stunted and do not set freely. This disease should be very easily controlled by dusting occasionally with sulfur when the fungus appears on the plants.

SCLEROTINIA ROT. **Sclerotinia libertiana,** a common rot producing fungus on many plants has been observed here, at least once causing severe damage to snap beans. This fungus thrives in

wet weather. It attacks the lower leaves, stems and pods, rotting them quickly. It is easily distinguished by the white cottony mycelium which covers the affected parts. No very satisfactory method of controlling this disease in beans is known. Beans should not be planted on land which bore a crop of Sclerotina affected lettuce or cabbage the previous season. (See Drop of lettuce).

MOSAIC This is a virus disease which has developed very destructively in beans in the United States in recent years. The symptons of this malady is a mottling of the leaves in light and dark green pattern. The dark green areas become more or less puffed, dwarfing and disorting the foliage. Affected plants bear scarcely any pods. The disease is infectious. The virus which is held to be the cause of the trouble is transmitted through the seed and is probably carried from diseased to healthy plants by sucking insects like the aphis. The prompt rouging out of diseased plants as soon as they appear so that other plants in the field do not become affected is to be recommended. This disease has been seen here on snap beans and also on the broad bean in which it is very prevalent and destructive. It also occurs on the bay bean **(Canavali lineata)** which grows over the sand dunes along the sea shore.

Cabbage

BLACK ROT. The most common disease of cabbage observed here is the bacterial disease, black rot, caused by **Bacterium campertre.** The symptoms of this disease are the formation of large pale spots about the edge of the leaves extending inward from the margins along the main leaf veins. These spots soon turn yellow and the veins of the leaf within these areas show black when the diseased leaf is held to the light. The bacteria soon work their way down the veins into the stalk. The affected leaves eventually fall away so that the plant either fails to head or the heads are loose and come away from the stalk easily. A soft rot, caused by **Bacillus caratovcrus,** often follows the black rot destroying the heads completely.

The bacteria are commonly carried on the seed. The disease is thus often established in the seedlings before they are transplanted. Seed disinfection will prevent such primary infection in the seed bed. This is accomplished by soaking the seed for fifteen minutes in a 1 to 100 solution of mercuric bichloride, after which they should be rinsed in clean water and dried in the shade.

The same organism causes a similar disease in many other cruciferous plants; turnips, cauliflower, kohl rabi and kale being commonly affected in Bermuda. It probably also occurs in some of the wild mustards here. The disease is thus active on one plant or another throughout the year, which is thus a source of inoculum. Snails and other insects as well as the wind disseminate the bacteria, so that while seed treatment will undoubtedly help, it cannot be expected to be a complete protection to the crop here.

SCLEROTINIA ROT. This disease affects cabbage very destructively in Bermuda during the wet seasons. It attacks the plants while they are growing long before they begin to head. The lower leaves lying on the ground are first attacked and rotted. Later when the heads are forming the fungus gets into them at the base and destroys them with a soft watery rot. The fungus which causes this disease produces the "drop" of lettuce (which see). Land on which a crop of lettuce or cabbage attacked by this fungus has been grown should not be planted to either crop again for two or three years as the fungus remains in the soil for some time.

LEAF MINERS. Tiny maggots, the larvae of a fly of the genus **Scaptomyae**, is exceedingly common in the leaves of seedling cabbage, cauliflower, kohl rabi, and kale in the early fall seed beds. The larvae burrow between the upper and lower epidermis of the leaf forming large whitish blotches. No method of control is known. Fortunately the seedlings are seldom killed and apparently not seriously injured by the insect.

Cannas

LEAF ROLLER. The cannas in Bermuda are severly attacked during the warmer months of the year by soft bodied long flat worms, the larva of the moth, **Calopodes ethlius.** This worm feeds on the leaves making a cut from the margin inward and rolling the flap of leaf thus made over its body, and sews the edges fast to the leaf with a gelatine thread. Emerging from the shelter thus formed it continues to feed on the leaf until it is full grown. Then within its shelter it pupates and finally emerges as a beautiful moth.

This pest should be easily controlled by spraying or dusting the plants with arsenate of lead.

Cauliflower

The chief disease of cauliflower observed is the black rot and the only insect pest of importance the leaf miner of seedlings. For a discussion of these see under Cabbage.

Changeable Rose

WEST INDIAN PEACH SCALE. The changeable rose, **Hibiscus mutabilis,** is quickly destroyed by the West Indian peach scale so destructive to oleanders here. Not only are the branches and trunk quickly covered with the scale coating, but the insect also infests the under side of the leaves. Spraying or washing the plant with lime sulphur 1 to 10 or Scaleside 1 to 15 will rid it of the pest. This treatment will probably defoliate the tree if the solution is applied to the leaves. Where the leaves have become infested this will however be necessary and will probably not seriously injure the plant, as new leaves will soon be put out. If taken early while the scale is still confined to the trunk or branches, the

pest may be removed by scrubbing the affected parts with Scalecide or lime sulphur without injury to the foliage.

Celery

SEPTORIA LEAF BLIGHT. This is probably the most common disease of celery in the Islands, and is responsible for heavy losses. Every celery grower knows and dreads the disease. It begins with a spotting of the lower outer leaves. If the weather is favourable to the fungus, **Septoria pertoselina** var **apii**, it rapidly spreads to the inner leaves and leaf stalks, spotting them and causing them to turn brown, wither and die. Not only are the plants injured in the field, but blighted celery does not ship well, arriving in the market, often in a worthless condition.

The fungus remains in the soil from one season to the next in the diseased leaves and stalks that are left to rot on the ground. Seed should always be sown on land which did not have celery on it the previous season. Diseased leaves and stalks should be promptly removed and destroyed, especially at harvest time. Spraying or dusting with bordeaux mixture or copper lime dust is very effective in controlling this disease. Seed beds should always be sprayed or dusted several times, and as soon as the plants have made good growth after transplanting, spraying or dusting should be begun and repeated every ten days or two weeks throughout the remainder of the season. A 4-4-40 bordeaux will be strong enough. If dust is used it should be applied at the rate of 1-4 to 1-3 pounds per square rod using a mixture of 15 pounds dehydrated copper sulphate (blue stone) finely ground and thoroughly mixed with the finest high grade hydrated lime. This dust mixture can now be purchased from several firms in the United States and Canada. Dusting is quite as effective as spraying, and much more rapid and convenient.

BLACK HEART. This disease was very destructive in many celery fields here last season. Several fields in the last stages of this disease were seen shortly after our arrival last June.

Black Heart is evidently common and destructive in the celery fields of Florida. The Florida Experiment Station has made a rather extensive study of the disease and its control. The cause of the disease is not certainly known, but is believed to be due chiefly to the use of certain fertilizers and to unfavourable soil conditions, especially excessive moisture. The use of nitrate of soda or kainit in the fertilizers gave black heart almost uniformly. A fertilizer composed of bone meal, fish scrap and high grade sulphate of potash gave, uniformly, freedom from this disease. A thorough test of this fertilizer should be made by Bermuda farmers.

DAMPING-OFF. This is a disease of the seed beds. The seedlings begin to die off shortly after coming up, in fact they are often killed before they get out of the ground and the grower concludes that the seed was poor. The trouble, however, is in the soil

and is a fungus, **Pythium species?** which is very common in Bermuda soils, attacking and killing many kinds of seedlings especially during wet weather.

This disease may be controlled by disinfecting the soil before sowing the seed, with a solution of formaldehyde. The soil should first be worked up loosely and leveled off ten days or two weeks before the seed is to be sown. Make up the necessary quantity of solution by diluting the commercial formalin (40 p. c. formaldehyde) at the rate of one part to fifty parts of water. With a watering pot or coarse spray apply this solution to the soil at the rate of about at least one half gallon per square foot of soil, or enough to wet the soil at least six inches deep. Cover for twenty-four to forty-eight hours with canvas. Remove the cover and allow the soil to air out for ten days or so and then sow the seed. This treatment of celery seed beds should also greatly reduce the spraying of the seedlings for the Septoria blight.

ROOT APHIS. See parsley.

Citrus

PURPLE SCALE. This scale appears to be the chief enemy of citrus fruits in Bermuda. Limes seem to suffer least and are the only citrus trees frequently found bearing fruit here. The few orange and lemon or grape fruit trees still to be found are almost without exception badly infested with this scale, many of them half dead. This scale, **Lepidosophes beckii,** is about an eighth of an inch long, purplish brown in colour and shaped somewhat like an oyster shell. It infests the branches, especially the younger twigs, the leaves and the fruits. The life history is much like that of the oleander scale, except that two months are required to bring the scale to maturity instead of one. Fewer eggs are laid by the female (40) and over a period of three or four weeks. In Florida there are three generations per year. Probably the same number are produced here. The young crawlers are most abundant in Florida during March or early April, June or July and September or October. The life habits and development of this scale have not been checked up carefully as yet in Bermuda. They probably correspond rather closely to developments of the scale in Southern United States and similar control measures there should be successful here.

Miscible oil sprays have been found to be most effective against this scale. A boiled emulsion made up as follows is said to be most satisfactory and effective. Cheap lubricating oil (obtainable from the Oil Company) testing 24o to 32o Baume and having a viscosity not less than 200, 2 gallons, water 2 gallons and soap (fish oil soap or hard soap) 2 pounds are boiled together. When the mixture has come to the boiling point thorough emulsification is effected by pumping the boiling hot materials into another vessel and back again with a common foot pump sprayer. This stock emulsion is then stored to be used when spraying the trees for scale. It is diluted at the rate of one part of the stock to fifty or sixty parts of cold water. Scalecide, a proprietary miscible oil

emulsion which may be purchased ready for dilution is also effective. It should be diluted at the rate of one part to thirty or forty parts of water.

In Florida four applications per year are recommended. These are: mid April, mid July, late October and middle of February. The April spraying should be deferred until the young fruits are an inch in diameter. Nothing will do more to revive the growing of citrus fruits in Bermuda than the general adoption a spraying programme by those who still have trees.

WHITE FLY. —Eight species of white flies are found on citrus in Florida. How many of these occur in Bermuda has not been determined, but at least one species, the cloudy winger white fly, **Dialeurodes citrefolii,** is common and very detrimental to citrus trees. The tiny white flies cover the under surface of the young leaves at times. Here they lay their eggs, one hundred per female. These soon hatch into pale yellow flat crawlers. Like young scales, (to which they are cousins) these larvae soon insert their beaks in the leaf and naver move again. They molt their skins several times as they grow. These immature white flies look like very thin almost transparent circular little scale insects on the lower surface of the leaves. The adults which are entirely different live but a short time, just long enough to lay the eggs. It is the young growing larvae which cause the injury.

Spraying as for the purple scale will control the white flies. Several species of parasitic fungi attack scales and white flies in Florida and are very effective in helping to keep these pests in control. Mr. E. W. Berger of the Florida Plant Board has kindly sent us cultures of those that attack the white flies and attempts are being made to establish these helpful parasites in the citrus plantings at the Station and elsewhere.

Corn

EAR WORM. This worm, probably the larva of the moth **Heliothis obsoleta,** causes severe damage to the corn crop, especially sweet corn, during the spring and summer. It begins its ravages on the young leaves at the centre of the stalk, eating them away and often preventing the proper development of the stalk. Later the worms attack the ears, rendering green corn unfit for the market.

This worm should be readily controlled by dusting the young plants with a mixture of powdered arsenate of lead and dry hydrated lime equal parts, as soon as the worms begin to appear . The ears may be largely protected by dusting with the same mixture when the silks appear. Danger to stock to which the fodder is fed should be very small, probably negligable, as rains would soon wash away most of the poison, and, besides, the amount applied would scarcely be dangerous to animals, unless the green fodder were fed shortly after applying the poison.

WEEVIL. There are two weevils attacking stored corn in Bermuda. At least one of them appears on the ears before they are husked in the autumn. Both the granary weevil, **Calandra granaria,** and the rice weevil, **Calandra orvza,** have been reported from corn in Bermuda. Fumigation of the corn before final storage with carbon bisulphide or carbon tetrachloride is the surest means of ridding the grain of these pests.

Cosmos

Red Spider. The yellow cosmos, **Cosmos sulphureus, was** severely attacked in the borders at the Station early in August by the red spider, **Paratetranychus humidus** Banks. This tiny red mite spins a very fine web over the under side of the leaves underneath which it lives and multiplies. The mite sucks the sap from the leaves causing them to turn brown and dry up. It spreads rapidly from plant to plant and will quickly destroy a large planting. Dusting once on the under side of the leaves of infested plants with finely ground sulphur completely eradicated the pest and saved the plants which, with a few exceptions, promptly put out new foliage and recovered.

WHITE MITE. A curious dwarfing and bronzing of the young leaves of the yellow cosmos was observed at the Station and elsewhere during July and August. Affected plants were much dwarfed or stunted and ceased to grow. Microscopic examination showed the presence of a very minute white mite, **Tarsonemus latus** Banks. The infestation at the Station became very general throughout the cosmos in a large border early in August. Half the plants were dusted with finely ground sulphur and the other half, with the exception of a few left as checks, were dusted with a 5 p. c. nicotine sulphate dust impregnated into dry hydrated lime. Both treatments were promptly effective. The plants rapidly recovered. New healthy foliage was soon produced and the plants flowered profusely except a few of the more severly injured ones.

Crab Grass

SMUT. The common crab grass, **Stenotaphrum secundatum,** the principal lawn and pasture grass of Bermuda is very generally affected with the smut fungus, **Ustilago affinis.** The mycelium of this fungus is apparently systemic and perennial in the prostrate caulms of this grass, replacing the seeds with its dark brown spore masses. As this grass flowers almost continually throughout the year, this smut is always to be found where ever sought. So common is it that many of the islanders look upon it as the pollen of the grass, a peculiar conclusion worthy of record and indicating the very abundant development of the disease here. The disease appears to cause relatively little damage. Even the most vigorous stands are commonly infested, and as the grass roots down all along the prostrate haulms at the nodes, the destruction of the seeds is of little detriment.

Endive

DROP. While endive is not much grown in Bermuda, it thrives wella s is demonstrated in a large test plot of several varieties at the Station this year. It was however destructively attacked as it approached maturity by the "drop" fungus, **Sclerotinia libertinna.** Careful counts made of diseased and healthy plants show that while most of the varieties in the test were seriously affected one at least was nearly immune. Two beds of the resistant variety, White Curled, showed but 14.8 per cent diseased as compared with 69.4 per cent. diseased in the nine other beds of seven varieties. Moreover the diseased plants in the white curled variety were, with one or two exceptions, only slightly affected. If the growing of endive in the Islands is to be developed, these data will furnish important evidence to be considered in the selection of varieties. Endive should not follow lettuce on the same land, especially if the lettuce has suffered from "drop". For further facts concerning **Selerotinia libertiana,** seed under Lettuce "drop".

LEAF HOPPERS. See under lettuce.

Fig

RUST. The fig trees of the Island are repeatedly defoliated throughout the year by the leaf rust fungus, **Cerotelium fici.** This fungus forms small powdery brown pustules over the under side of the leaves, causing them to turn a dark purple above, then brown and crisp, as though scorched, just before they drop away. This constant defoliation either prevents the setting of the fruit or more commonly causes it to drop when nearly full grown, but before it can ripen. Applications of sulphur dust applied to a tree full of fruit at the Station held the leaves and enabled the fruit to ripen, while adjacent trees untreated lost both foliage and fruit. The trees should be dusted frequently during spring and summer. Abundance of figs as of old could be produced in Bermuda, if this rust is controlled.

SCALE. A small circular black scale, **Morganella maskelli,** is very abundant on the branches especially toward the tips of many fig trees. It appears to be responsible for the killing of the branches in some cases. Spraying with lime sulphur one to ten or some oil spray like Scalecide or the oil-soap mixture described under Purple Scale of citrus in the winter when the trees are leafless should destroy this pest.

Grapes

POWDERY MILDEW. This mildew appears to be about the only disease affecting grapes in Bermuda. It is prevalent during the growing season of the vine, coating the leaves and fruit with a fine powdery white growth. The fungus, probably **Uncinula necator,** not only saps the vitality of the leaves, but it also stunts the fruit or halts the growth of the skin, so that as the fruit begins to ripen it cracks open and spoils. The scattered steting of berries on the bunches, so common this past season, was probably due to

the mildew. Dusting frequently during the spring and summer with sulphur will certainly control this disease.

Hibiscus

SCALE. Hibiscus hedges are frequently more or less infested with a large dark brown scale, **Saissetia nigra.** It seldom seems to cause any serious injury. This is doubtless due to a small fly-like parasite, **Leconiobius cookerelli.** The eggs of this minute parasite are laid in the soft body of the scale beneath the shield. The developing larba kills the scale and emerges as an adult through a minute hole in the top of the shield. This parasite appears to be very abundant in Bermuda and may be depended upon to keep this scale in control.

Kale

BLACK ROT. See under cabbage.

Lettuce

DROP. This is the most common and the most destructive disease of lettuce in Bermuda. It is especially destructive in wet seasons. The Coss or Romaine variety, which is the only one grown for export here, is quite as susceptible as any of the flat growing head lettuce. Counts of the diseased heads of cos lettuce in the variety test plots at the Station showed a loss of 39.5 per cent in five beds, each a different variety. The lowest percentage of loss in any of the five varieties was 23 per cent. Lettuce had been grown on these beds last year. The little goblet shaped fruit bodies of the pathogene, **Sclerotinia libertiana,** were to be found all over the ground among the plants. These apothecia arise from the black tuber-like sclerotia of the fungus left in the soil from last year. These sclerotia are about the size of small peas and are produced in great numbers all over the rotting heads of lettuce. The rot starts on the outer leaves, spreads rapidly to the heart destroying the head in a few days. The rot is started by the microscopic spores of the fungus shot into the air from the cup shaped apothecia.

Losses from this disease may be greatly reduced by a systematic removal of diseased heads as soon as the rot starts. This prevents the spread of the white cottony mycelium to adjacent plants, and what is even more important, prevents the seeding of the soil with the tuber-like sclerotia of the pathogene. The sclerotia are produced in the last stages of the decay of the heads and are left on the soil to infect the following crop. Not only is lettuce attacked by this fungus, but also endive, beans, cabbage and other succulent crops suffer severely. This fact should be borne in mind in planning for succeeding crops on infected soil.

STUNT. This peculiar disease has but recently been noted in the lettuce growing sections of northern United States. Affected plants are stunted, produce few leaves and these are long and weak. In the Boston head and Icebery types the leaves of diseased

plants are usually strikingly reddened; in cos varieties they are usually white.

The disease is caused by a soil inhabiting fungus, a species of **Pythium?** The disease has only recently been studied and no satisfactory method of control is known. It is very probable that disinfection of the soil of seed beds as for damping off (see under celery) would greatly reduce losses. Infection appears to occur in Bermuda in the seedlings before transplanting. The parasite invades the root but does not rot or otherwise seriously affect it. The injury is in the foliage. The percentage of infected plants in the Station variety test plots this season is not less than twenty-five. The disease has also been found in most of the farmers' plantings examined.

LEAF HOPPERS. The cos lettuce and the broad-leaved endive at the Station were both attacked by leaf hoppers early in the fall after they were well established. The lower leaves became bleached about the margins and died off. Hoppers in great numbers were found on the lower surface. Dusting with a five per cent nicotine sulphate in hydrated lime should control this pest. The dust must be gotten on the underside of the infested leaves.

Lilies

STUMP ROT. This disease attacks the Easter lily as the plants come through the soil or shortly thereafter and continues to attack them throughout the growing season whenever weather conditions are favourable. The fungus which causes this disease is a species of **Phytophthora.** The pathogene is harbored in the soil. Spores produced at the surface of the soil are splashed by falling rain into the crowns of the plants. Here a rot is rapidly set up which may destroy the entire stalk down through the bulb. Or only the growing tip may be killed leaving a stump with a rosette of leaves, hence the name "stump rot" given it by the growers. Secondary shoots often arise from this stump, or from the bulbs, but such shoots are small and weak. The bulbs of affected plants make little or no growth and the stock formed are few and small. Attacks shortly before flowering are common. In these ceases the tip of the stalk alone is usually killed.

Losses from the stump rot this season have been very heavy. Careful counts of diseased plants in five beds of over 900 bulbs each, showed, up to the first January, 43 per cent infection. Plants affected thus early in the season may be regarded as a dead loss. This disease is more or less prevalent in nearly all the lily fields of the Islands, and will reduce the crop around twenty-five per cent.

Spraying with bordeaux mixture or dusting with copper lime dust (see celery blight) beginning just after the plants are up and repeating it every week, if the weather is rainy, should hold the stump rot in check. Disinfection of the soil with formalin as for damping-off (see under celery) should be very helpful especially where bulbs are to be planted on land in which the disease has been bad in former years. The fungus seems to persist long in the soil.

BLACK SCALE. This is in some respects the most serious disease of lilies in Bermuda. It is almost certainly to this disease for the most part that the so called "running out" of lily stock is to be attributed. There are several well marked symptoms. It is known to the growers, as the name suggests, from the black rotten outer scales on many bulbs at time of digging. Most growers however do not look upon these black scales as a disease symptom. Neither do they connect this condition with the so called premature ripening off of the trees, that yellowing and dying off of the leaves from the ground upward, so general in the lily fields during May and June or even earlier. Another symptom, almost certainly of this disease, is the brown dead spots and yellowing of the leaves accompained by a rotting of the roots to be observed as early as December in plants here and there in the beds. Plants thus early affected are the most susceptible individuals. The number of such plants increases rapidly as the trees begin to shoot upward. By the middle of June or earlier a very percentage of the trees in most lily fields were dead or dying. However there were among them fine large trees with leaves green and healthy to the ground and most of these continued green right up to digging time.

About the middle of June some 200 each of healthy and diseased (dead) trees were marked on each of three farms. At digging time these were taken out separately with their stock. The trees marked healthy were resorted rejecting any that showed spotted leaves or black scales on the bulbs. The healthy mother bulbs and stock was stored by themselves, as were also the bulbs and stock from the dead trees. A comparison of the bulbs and stock of the two lots as they came from the soil would have convinced any unprejudiced person of the superiority in every respect of the bulbs and stock from the green trees over those from the dead trees. This superiority is again most strikingly evident in the trees growing this season from the healthty bulbs along side those developing from the bulbs from the "dead" trees. Already many of the trees from the diseased stock are showing the spotted yellowing lower leaves so characteristic of this disease, while those from the healthy stock are green and healthy and markedly superior in size and general vigour.

The difference between these two lots of bulbs selected from each of these three fields is simply that of resistance to the disease and indicates clearly the method to be employed in combatting it. Spraying may be of some assistance in protecting the foliage, for the disease is caused by a fungus. However, the surest method is selecting and propagating from those trees only that retain their green leaves from the ground up until digging time or at least ripen off from the top down, not from the bottom up. All other bulbs should be at once disposed of in some way along with the stock from them. They should not be planted again.

It has been clearly established that the disease is caused by a fungus, but the identity of the pathogene has not yet been determined.

OTHER DISEASES. There are at least three other important diseases of lilies in Bermuda. They have not as yet been carefully studied, but appear to be of the nature of mosaic or leaf-roll diseases. The prompt elimination of all, such disease affected trees from the beds is to be strongly recommended. A thorough investigation of these diseases is highly desirable, but the time at my disposal here does not warrant beginning work on them. Several seasons of continuous study and field testing will be necessary to profitable results on these obscure maladies.

Oleander

THE SCALE. Much time and energy has been devoted to study, observation and experiments on the West Indian Peach scale, **Aulacaspis pentagona,** during the past seven months. This scale is known to have been present in Bermuda on the oleanders as early as 1917. The facts regarding the history of this insect in these Islands and the efforts and measures for bringing it under control are fully set forth in the report of the Director.

This scale now generally known in Bermuda as the oleander scale is believed to have originated in Western Asia and its original host to have been the peach. It is now wide spread in tropical and sub-tropical countries. It is very common in the West Indies from which it was doubtlessly brought into Bermuda on some one or more of its numerous host plants. No less than twenty-five different species of plants have been found to be attacked by this scale in Bermuda. Among these the most important are; the oleander, peach, geranium, sago palm, bryophyllum or life plant, changeable rose, potato and the pepper.

Two other scale insects occur here on the oleander, a rather large black one, **Saissetia oleae,** and a small black one, **Marganella maskelli.** Neither of these appear to cause much injury to the oleander. The snow white colour of the masses of **Aulacaspis pentagona** which coat the branches of infested hedges at once distinguish it from these black scales and the rapidity with which it kills infested trees marks it at once as a dangerous pest. The soft bodied pink females are covered with a white shield with a pink centre, the cast skin of its childhood. The shields of the females are nearly circular and much larger than those of the males which are long and narrow and pure white except for the pale pink infant skin at one end. On badly infested branches the female scales completely coat the surface and often over-lap. The males form dense patches of flaky white, usually toward the base of the shoots. At maturity the males hatch into minute red bodied flies scarcely visible to the naked eye. The females never leave the spot where they settle just before the first molt. After fertilization by the males they each lay from fifty to one hundred eggs under the shield. These soon hatch into minute pink crawlers that migrate up the branches to fresh feeding grounds where they soon begin to feed and exude fine waxy hairs from their bodies giving to a branch covered with them a fuzzy pink appearance. A new brood was produced each month from June to October and new broods were also observed

here and there during November and December. The cold rainy weather of the winter months seems to slow up their development considerably, but apparently does not stop it entirely.

Badly infested trees are rapidly killed to the ground once the scale has covered the main trunk completely, but it probably takes six months or more from the time the first few scales appear on a shoot before this happens. Clumps or hedges killed to the ground will usually throw up new shoots which thrive for a time only to succumb later to infestation from the old crowns on which they have developed. Most hedges do not appear to recover at all after being twice killed back. Destruction of the scales by thorough spraying with lime sulphur will not only promptly revive badly infested trees but will also stimulate the development of much stronger and more vigorous shoots from the crowns.

It is doubtful whether the most thorough spraying can completely eradicate this scale from a hedge once it is infested. There is not only the difficulty of hitting every scale with the mixture, but there is the constant probability that birds or ants will carry young scales from infested floppers (Bryophyllum), geraniums, or from any one of the two dozen other hosts which the scale infests, and colonize them again on the trees. Spraying healthy trees to prevent infestation is useless. From observations made on trees sprayed at the Station last March it appears probable that one or at most two thorough sprayings each year using lime sulphur one to ten or Scalecide one to fifteen will give perfect control. It may be that once the general infestation over the Islands is cleaned up even less frequent sprayings will be required.

In several countries where this scale has been destructive, notably southern United States, it is now almost completely kept in check by a minute fly-like parasite, **Prospaltella berlesei.** Through the kind assistance of Dr. L. O. Howard, Chief of the Bureau of Entomology of the United States Department of Agriculture, we have obtained two small shipments of this parasite which have, we hope, colonized themselves on the scale in several patches of infested floppers where the material was placed late last summer. It is hoped that more of this parasite may be obtained in the spring At best little help can be expected from Prospaltella for several years, as it will take some time for it to multiply and spread over the Islands, even with such assistance as may be given by distributing it over the Colony.

LEAF SPOT. A leaf spot fungus, **Septoria oleandrina,** causes dead gray spots usually about the margins of the older leaves. The disease is seldom serious, but sometimes rather severe defoliation results.

Onion

PINK ROOT. This appears to be about the only disease of importance in the onion crop of Bermuda, although at times in the past the blight caused by **Peronospora Schleideniana,** is said to have been very destructive.

The pink root is caused by a soil fungus, **Fusarium malli,** which attacks the roots only. The affected root turns a purplish pink colour at first, then gradually becomes brown and rots away. Not all the roots of the plant are killed off in time, usually only a few of them being affected, but they continue to be attacked and destroyed all through the season. As the roots are thus killed off the plant is compelled to put out new ones to replace them. The loss of the roots causes a dying back of the leaf tips due to the cutting down of the water supply. The gray effect given the onion seed beds all over the Islands this autumn and winter by the dying of the tips of the leaves was very striking. This means that practically every onion set went into the field diseased. Only the most favorable temperature conditions during the early part of 1922 can save the crop from severe injury from this disease. The records show that the average annual production of onions in the Colony during the last decade is over fifty per cent less than that of the previous ten years. It is also well known that the crop is matured and harvested later than it used to be. Considering all the evidence at hand, it is quite clear that the present low yields, late maturing and small size of the bulbs, are to be attributed largely to this disease.

This disease is very general and destructive in the onion fields of Texas, where it was first discovered and studied. From the results obtained on its control in Texas during the past four years, it appears that some relief may be had here from its ravages. The disinfection of the onion seed beds with formalin as described for damping-off (see celery) should become a general practice. This will give good strong healthy sets for transplanting, instead of the diseased and often stunted plants now commonly grown. After the transplants are well established in well fertilized soil, apply nitrate of soda at the rate of 100 pounds per acre. One or two more applications of a like amount at intervals of two or three weeks should follow, especially if the leaf tips begin to die back, the sign that the fungus is at work on the roots. Bermuda soils appear to be so generally infested with **Fusarium malli** that the advantage of planting healthy seedlings on clean soil cannot be taken by the growers here. Neither is a long rotation of crops usually possible under Bermuda conditions. The liberal use of nitrate of soda on the growing crop stimulates rapid growth, thus enabling the plant to overcome to a large extent the attacks of the fungus through the prompt putting out of new roots.

Palms

Generally speaking the many species of palms growing in Bermuda are surprisingly free from pests and diseases. The only troubles of importance thus far observed are as follows:

WHITE SCALE ON PALMETTO. On the 22nd. November a native palmetto in Somer's Garden in St. George's was observed to be badly infested with a white scale, **Comstockilla sabalis** (Comst.) which was rapidly killing the tree. What appears to be this same scale was shortly after reported to be general on palms in many of the West Indies. Prompt steps were taken to have this

tree cut down and destroyed. This was done by the Corporation of St. George's and no other case of this pest in the Islands has been found. This is evidently another case of the introduction of a dangerous pest from the usual source of such dangers, and emphasizes the desirability of a strict quarantine against importation of plants from the West Indies.

OLEANDER SCALE ON SAGO PALMS. Sago palms (**Cycas revoluta**) are becoming rapidly infested throughout the Colony by this insect, **Aulacaspis pentagona.** The scale rapidly covers the underside of the leaves and kills them. Spraying the under surface of the leaves as for the pest on oleanders is to be recommended.

BROWN SCALE OF SAGO PALMS. Many of the palms have the under sides of the leaves literally coated with a large brown scale, **Saissettia hemisphaerica.** It does not appear to seriously damage the foliage, due possibly to the presence of parasites which destroy the scale before it causes serious damage. Spraying with oil spray like Scalecide should eradicate the insect where it seems to be causing damage.

GRAPHIOLA LEAF SPOT. This disease is rather common on some species of palms here, especially species of **Phoenix.** It causes disfiguration of the foliage, especially of the older leaves. These should be removed and destroyed. It is caused by the fungus, **Graphiola phoenicis.** Spraying experiments for the prevention of attacks by this parasite do not appear to have been recorded. Fungicides like lime sulphur or bordeaux mixture should be effective against this fungus.

Papaw.

YELLOW LEAF. This disease is rather common. Affected leaves, usually the lower older ones, yellow and fall prematurely. This affects the growth and proper maturing of the fruit. The disease is caused by **Pucciniopsis caricae,** a fungus which produces irregular patches of minute black fruit bodies on the lower side of the leaves. Spraying or dusting with one of the standard fungicides should control this disease.

FOWDERY MILDEW. The most serious disease of papaws in Bermuda appears to be a mildew caused by some species of the Erysiphaceae. The white superficial mouldy growth of the fungus develops in large patches on the upper surface of the leaves, causing them to yellow and die prematurely. It is especially severe on seedlings, which are thus stunted and slowed up in their growth and development. Dusting with sulphur has proven very effective in freeing plants of this fungus.

Parsley

ROOT APHIS. Parsley appears to be exceptionally free from diseases and pests. A root aphis (species as yet undetermined) is however wide spread, and is said to occasionally destroy entire fields of this crop. The small bluish gray insects develop in

large numbers on the roots and crowns of the young plants causing the leaves to turn yellow and die. This injury results from the sucking of the sap from the roots and base of the leaves by the hundreds of aphids which crowd each other for place on these tender parts.

Some preliminary tests with tobacco extract indicate that where the pest threatens the crop, relief may be had by pouring a one to four hundred dilution of Black-Leaf-forty along the rows. The same insect has been found on the roots and crowns of celery in the seed beds.

Peach

RUST. This disease is general throughout the Colony on the few peach trees which still persist. It is caused by the fungus, **Tranzschelia punctata,** wide spread and common on this host in warm countries. The fungus attacks the leaves, covering the under surface with numerous minute powdery brown pustules and causing them to yellow and fall. Peach trees in Bermuda are rarely seen with a full complacement of leaves during the growing season even. This continuous defoliation prevents the proper setting of fruit and gradually kills the tree through its weakening effect. Frequent dusting with sulphur should protect the leaves from this rust.

SCALE. The West Indian Peach Scale so destructive to the oleanders is even more dangerous to peach trees which are quickly killed by its attack. Spraying with lime sulphur one to ten will eradicate the scale, but will also take the leaves off the trees. For this reason spraying of peach trees should be done during the early winter months when the trees are entering the dormant leafless condition.

FRUIT FLY. The Mediterranean fruit fly **(Ceratitis capitata)** is the most serious insect pest, not only of peaches but also of most other fruits in Bermuda. The fly lays its eggs in the maturing fruit. A grub hatches from this egg and feeding upon the flesh of the fruit renders it unfit for food. An attempt some years ago to completely eradicate this pest by cutting down fruit trees throughout the Islands failed, and it is now permanently established. This insect which is wide spread throughout the Old World tropical and semi-tropical countries, the Orient, South Africa, Australia and Hawaii, is as yet unknown in the West Indies and the mainland of North America. It is this insect that is chiefly responsible for the stringent quarantines laid by the United States Federal Horticultural Board against Bermuda plants and fruits.

In South Africa the pest is effectively controlled by spraying with arsenate of lead sweetened with a little sugar or syrup. The bait used is made by dissolving five or six pounds of brown sugar in ten gallons of water and adding half a pound of arsenate of

lead (paste) or one fourth pound of the dry powdered form. Three pints of cheap molasses may be substituted for the sugar. Experience in the United States with the cherry fruit fly, a cousin, of the Mediterranean fruit fly, is that no sweetening of the bait is necessary. Beginning when the peaches are about two thirds grown apply a little of the bait to the foliage on different parts of the tree, repeating the application every week or so, especially if the weather is rainy. The flies drink the poison whenever the leaves are wet with rain or dew, and are killed before they can lay their eggs in the fruit. The same treatment may be used to protect other fruits like the loquat which are attacked by this fly.

Peppers

OLEANDER SCALE. Peppers, especially the small fruited perennial species, are commonly infested with **Aulacaspis pentagona.** If taken in hand while the scale is still confined to the trunk, infested plants can be cleaned up by scrubbing with lime sulphur one to ten. The foliage would probably be killed by spraying with this solution. Badly infested plants should be destroyed.

FLEA BEETLES. Small black flea beetles (species undetermined) were found doing serious damage to a plantation of the large red peppers. A thorough application of bordeaux mixture made up with an excess of lime quickly drove the insects from the plants. They are difficult to poison, but dislike to feed on plants coated with lime wash or bordeaux.

FRUIT FLY. Peppers of all sorts are much infested with the Mediterranean fruit fly. For treatment see under peaches.

Periwinkle

LEAF AND TWIG BLIGHT. The very commonly planted ornamental, **Catharanthus roseus,** is severely attacked in some gardens during November and December by a species of **Phytophthora,** probably **P. parasitica** which attacks the same host in India. The disease affects the leaves, seed pods and tender tips of the twigs, killing them quickly and with symptoms like those of the late blight of potatoes. Spraying the plants during the period when the disease usually appears with bordeaux mixture should fully protect them from this disease.

FLAT STEM BORER. Several periwinkle plants of large size were observed during the summer to gradually turn yellow and then suddenly wilt and die. Examination showed the presence of many flat white larvae about the crown beneath the bark which they had gradually loosened all about the trunk by burrowing between the wood and the outer layer of bark. They are doubtless the larvae of some beetle no adults of which have been found. Plants showing a yellowing of the foliage during the summer or early autumn should be examined, and if attacked by this borer should be promptly pulled and burned.

Potato

EARLY BLIGHT. The early blight caused by **Alternaria solani** was very general and caused serious injury to the fall crop in many fields. It appeared in early planted Bliss about the first week in November and by the first of December had more or less destroyed the foliage on one third of the fields. The heavy winds of early December completed the destruction, except in a few protected fields and late plantings. Those that escaped the wind were soon after rapidly killed by the early blight. The severity and rapidity with which the disease developed gave much the appearance of an epidemic of late blight.

The early blight fungus is harbored on the land from one season to the next in the debris of the last crop. The common practice of removing the old tops from the land after digging is of little value in eliminating the fungus as the diseased leaves have dried up and fallen. The spores in the soil are splashed by the rains to the lower leaves where the disease first appears. From these it spreads to the leaves above. Early blight is usually to be distinguished from late blight by its smaller definite brown lesions in the leaves and the target board markings which adorn the spots in contrast to the large indefinite water soaked spots of the latter. However, the very wet weather evidently stimulated an abnormal development of the early blight spots which were large and indefinite in outline and very similar to those of the Phytophthora blight. These were of a browner colour and lacked the downy white mildew so characteristic of the lower surface of the lesions of the late blight. Moreover, many typical small lesions of the Alternaria blight were always to be found on some of the leaves and repeated microscopic examinations of the large lesions always disclosed great numbers of the spores of the Alternaria, never any of the Phytophthora.

The yield in early blighted fields was greatly reduced, probably one third. Bermuda growers do not appreciate the serious character of this disease. In fact most of them look upon it as the natural maturing of the trees or at most premature ripening due entirely to the weather. It does not cause a rotting of the tubers as does the late blight and this may be the reason for the growers' indifference to its presence in their fields.

Early blight is difficult to control and only thorough spraying begun before the plants are moulded will be effective. Three or four thorough sprayings with bordeaux mixture at intervals of ten days or two weeks made early in the season will protect the lower leaves where the fungus first starts its attack. By completing the sprayings just before the trees make their final growth of leaves the disastrous effects of heavy winds on recently sprayed foliage will be much reduced. Bermuda growers begin spraying in their fall crop much too late. Early blight was well established in many fields this past season before the first application was made.

LATE BLIGHT. This disease was not observed anywhere up to the end of December in the many fields under observation. It evidently appeared however very late in a few fields as tubers affected with the disease were found in some lots delivered at the dock for export.

The late blight is caused by the fungus **Phytophthora infestans,** which is carried over from one crop to the next in the diseased seed tubers. The continuous period of dry weather throughout the season on Long Island, where the bulk of the Bliss seed is grown, and the equally dry weather under which Bermuda grown seed was produced last spring may have all but completely eliminated the late blight fungus from the seed tubers used for the fall crop. This appears to be the only explanation of the almost complete freedom of the crop from the late blight. Weather conditions during November and December were certainly ideal for the epidemic development of the disease had the pathogene been generally present in the seed.

WIND INJURY. Heavy winds on December fifth, sixth, and seventh, caused disastrous injury to the potato crop throughout the Colony. The damage was least on St. David's Island. In many fields the foliage was completely whipped from the trees or was so badly torn and bruised that it quickly died. It is estimated that this early killing of the tops reduced the yield of tubers one third. The wind injury together with the killing of the foliage in many fields by the early blight undoubtedly reduced the total crop of the Islands one half. The growth of the potatoes on the first of November both in size and colour of foliage was said by growers generally to have been the best in many years and promised a bumper crop. Not only were the yields generally low, but the grade of the tubers was poor with relatively few firsts in most fields.

Potatoes sprayed just before the heavy gale were in general more severely injured than the unsprayed. This was clearly demonstrated in the experimental plots at the Station. The foliage on plots grown from seed produced in Wisconsin and New Brunswick were much less severely injured than that in plots grown from Long Island seed immediately along side. The northern grown seed stock undoubtedly produce a hardier much less tender foliage than does that produced further south.

LEAF ROLL AND MOSAIC. The prevalence of these two diseases is fully set forth in the Director's report on potato seed stock. A few important facts and theories regarding these two most important diseases should be presented here. While very different in the symptoms by which they are known, both these diseases have many characteristics in common. Both are virus diseases, that is believed to be caused by some kind of living organism not yet discovered by investigators. Both are infectious, that is they may be transmitted from plant to plant by injection of sap or by insects, especially aphids. Both are carried over to succeeding crops in tubers from diseased plants, and tubers from diseased plants almost invariably give rise to diseased plants. Both mosaic

and leaf roll cause marked reductions in the crop, this being generally the more marked in the case of leaf roll as Bermuda growers have come to well understand. The continued planting of stock affected with either or both of these diseases shortly results in the so called "running out" of the stock. This destructive increase of leaf roll and mosaic in Bermuda grown seed after the first year is undoubtedly due to the general presence of the aphis and leaf hoppers in the potato fields and the large numbers of volunteer potato trees that come up in every field. These volunteer plants are almost all from the small tubers left on the land at digging time and produce a high percentage of leaf rolled or mosaiced plants. These diseased volunteers serve as the source from which the virus is carried by aphids and other sucking bugs to the healthy plants in the planted crop. In spite of the fact that growers know the danger of planting seed grown more than one season in the Islands, many did it last fall and lost heavily. Some fields from such stock showed over sixty-five per cent of leaf roll plants of the most dwarf type.

The prevailing belief among farmers that these diseases and especially mosaic are due solely to the weather is perhaps a natural one from their point of view and with their lack of knowledge of the true nature of these maladies. Mosaic symptoms at least are much influenced by temperature conditions, coming out clearly in cool weather and remaining undeveloped or masked in warm weather. However, unless the virus of the disease is in the seed tubers when planted mosaic symptoms will not appear no matter how cool and favourable the weather.

The very excellent system of seed potato field inspection and complete control of importations of seed stock maintained by the Board of Agriculture here probably gives the potato growers of this Colony the best grade of seed potatoes, at least so far as disease therein is concerned, of any similar group of growers anywhere in the world. Both farmers and importers of seed potatoes in these Islands should insist on the continued maintenance of the present standards and regulations. Disease free seed potatoes is not only fundamental to but absolutely necessary for profitable potato production in Bermuda.

SCAB. This disease is said to be more common in the Bliss crop this winter than for many years. Scabby potatoes were to be found in nearly every field at digging time. In some fields as high as fifty per cent of the tubers were too scabby to ship. There was considerable scab in both the imported Bliss and Garnet seed, some barrels running over fifty per cent of the tubers scabby.

Practically none of the growers treat the seed before planting.

Scab is a bacterial disease caused by **Actinomyces chromogan-us.** a soil inhabiting organism. Once it becomes established in the soil it seems to remain there indefinitley, but attacking potatoes only under certain favourable conditions. The most important of these conditions appear to be a proper soil temperature at the time the tubers are developing, and an alkaline condition of the soil. If

there be none of the scab bacteria in the soil, scabby seed together with the proper combination of the soil temperature and alkalinity will also give a diseased crop. The well known erratic behaviour of scab in Bermuda is to be explained by the lack of one of the favourable factors most seasons or in most fields.

Soils on which scabby potatoes appeared this season are undoubtedly too alkaline and are apt to give scabby potatoes again at any time the soil temperature favours. An application of finely ground sulphur to such soils at the rate of about six hundred pounds to the acre to make it acid should be tried. This is proving very successful on scab infested lands in New Jersey. Treating the seed with formaldehyde solution one pint to thirty gallons, soaking the tubers for two hours before cutting, should become a regular practice with Bermuda growers.

FUSARIUM ROT. Considerable Fusarium stem end rot and blackening was observed in some lots of Bermuda grown seed. It was also present to some extent in the imported Bliss seed. There was, however, little evidence of the Fusarium wilt in the fall crop, doubtless due to the cold rainy weather which is unfavourable to the fungus, **Fusarium oxysporium**, which causes this disease.

There was more or less Fusarium dry rot in the Garnet seed when it arrived. This rot spread through the barrels in storage causing much loss in some cases. The same thing happened in the Bliss stock in the autumn, but in spite of a general warning by the Director of Agriculture that growers immediately sort the seed upon taking it from the dock and store it in a cool place in open crates, many growers left it in the barrels until planting time or for some time at least and suffered accordingly. The practice of sorting the seed and storing in crates should be generally practiced, not only with the Bliss stock but also with Garnets, especially when they show any dry rot or late blight rot on arrival. Some of the growers mistook the Fusarium rot in the Garnet seed for that caused by late blight. No late blight rotted tubers were found in any of the Garnet seed inspected and but a single tuber in the Bliss stock. As already pointed out this practically complete absence of late blight in the imported stock this season was due to the very dry season in the seed growing sections of Long Island and eastern Canada this past summer. The same dry hot weather was, on the other hand, largely responsible for the unusual development of the Fusarium rot in the imported tubers.

FALSE CHINCH BUG. A rather severe outbreak of the false chinch bug, **Nysius ericae,** occurred on potato foliage early in the fall in some of the fields about Devonshire Marsh. This small dark gray sucking bug about an eighth of an inch long appeared in great numbers on many plants especially where the purslane, a weed, had grown up thickly among the potatoes. This insect was found abundantly on the purslane in other places which is apparently the favourite food plant of the insect here. It occurs on many weeds and some succulent crops like beets in the United States but has not apparently been reported before on potatoes.

As soon as the purslane was weeded out of the infested fields the bugs disappeared from the potatoes.

This insect kills the leaves by sucking out the sap causing them to first wilt and then dry up. Should it become serious in potatoes it should be readily destroyed by spraying with a good contact insecticide like Black-Leaf-40 or a 5 per cent. nicotine dust. See U. S. Farmers Bulletin 762.

FAILURE OF GERMINATION. Irregular areas were observed in several fields where the potatoes failed to come up. An extensive examination of seed pieces disclosed a peculiar condition. Those at the centre of the areas showed practically no springing of the eyes. As one approached the margins of these areas sprouts were to be found on the seed pieces, but they were short, swollen at the base, hard and red. Often small prematurely formed tubers were developed from the eyes. At the margins of these areas the shoots came through the ground, but were stunted and the bases swollen. Eventually plants came up here and there over the area but remained small and sickly. Most of them never came up at all and the seed pieces were to be found firm and unrotted at digging time.

The cause of this condition was not definitely determined. A small red mite, **Rhizoglyphus hyacinthi**, was found constantly associated with the stunted sprouts and was present on all the seed pieces in these areas in considerable numbers. This minute reddish mite is a common pest of the bulbs of lilies and other plants. Whether it was the cause of the trouble is not certain, but much circumstantial evidence aside from its constant presence about the base of the sprouts supports this idea. This trouble is not a new one to Bermuda potato growers. It occurs here and there in fields nearly every year in the fall crop, but rarely or ever appears in the spring plantings. This is probably due to the warm soil temperature in the autumn which favours the activities of the mite. The parasite is apparently abundant in such areas of soil becoming injurious only under certain conditions. The same areas are apt to suffer when planted to potatoes the following autumn and gradually increase in size. Some growers have treated such areas in the past with heavy applications of sulphur and lime or sulphur, lime and salt with excellent results. Sulphur is known to be a specific for certain mites and this evidence further strengthens the theory that this red mite is the cause of this peculiar trouble. Such areas should be treated with finely ground sulphur at the rate of about 600 pounds per acre immediately after lifting the crop, or in the fall when fitting the land for the autumn planting.

APHIS AND LEAF HOPPERS. These sucking insects were found in practically every field examined for them, especially the former. They are known to the chief agents of the transmission of mosaic and leaf roll as pointed out above. In addition to this they both cause serious injury to the foliage at times. A field badly infested with aphids was observed to have been badly burn-

ed by bordeaux while an adjacent planting in which few aphids were to be found was not injured by bordeaux applied at the same time.

A severe case of hopper burn or tip burn as it is usually called was observed in a field in Southampton. The leaf hoppers were very abundant and rose in clouds as one walked through the field. These small greenish white insects work on the under sides of the leaves sucking out the sap and causing the foliage to turn brown and dry up as though scorched by fire. Dusting with a 5 per cent nicotine dust should rid a field of both these pests.

Roses.

POWDERY MILDEW. This is a very common disease of roses, especially during the summer and early autumn. The leaves are coated with the powdery white growth of the fungus, **Sphaerotheca pannosa.** The young leaves become much puffed and distorted while older leaves turn yellow and fall prematurely. Dusting frequently with sulphur is the standard remedy for this disease

BLACK SPOT. This is also a common disease on many varieties of roses in Bermuda. It works on roses throughout the year. The fungus, **Diplocarpon rosea,** which causes the black spot grows in circular patches just beneath the cuticle of the leaves on the upper surface, forming black areas of various sizes. Affected leaves soon turn yellow and fall. The defoliated condition of many rose bushes especially during the summer is due to this disease. Black spot is also readily controlled by dusting with sulphur.

LEAF SPOT. Certain varieties of roses here suffer from a leaf spot caused by the fungus **Mycosphaerella rosigena.** The lesions produced by this pathogene are reddish purple with a light almost white dead centre. The disease causes defoliation. It will also doubtless be prevented by dusting with sulphur.

Rose growers will obtain a much better growth of foliage and a consequent increase in the size and quantity of blooms if they make a practice of dusting their roses regularly every week or ten days with finely ground dusting sulphur.

Sweet Potatoes

LEAF SPOT. A leaf spot caused by the fungus, **Phyllosticta bataticola**? is very common in the sweet potato fields over the Islands. In some cases it appears to cause rather severe killing of the foliage especially in the autumn. Affected leaves are dotted with small dead spots of a light colour. The leaves gradually yellow and die. This undoubtedly reduces the yield in spite of the fact that the plant puts out new shoots and leaves. Dusting with copper lime dust as on celery or potatoes should protect the sweet potatoes from this disease. Whether or not it would pay could only be determined by trials carefully checked.

FIRE WORMS. Green worms called by the growers fire worms cause much damage by eating the leaves of sweet potatoes as well as Irish potatoes and other crops. Dusting or spraying with arsenate of lead or other arsenicals when the worms first appear will destroy them before they can do serious damage.

Tomatoes

SEPTORIA LEAF BLIGHT. This is the only serious disease of tomatoes observed during the summer and autumn. It is caused by the fungus, **Septoria lycopersici**, which causes small dead spots in the leaves. This spotting of the foliage begins always on the lower leaves. The spots are at first pale and watersoaked in appearance. They soon turn dark brown with a pale centre in which may be seen the minute pimple like fruit bodies of the parasite. From these fruit bodies spores ooze in great numbers and are splashed by the rain to the leaves above thus spreading the infection. During rainy weather the disease works rapidly killing the foliage and greatly reducing the size and numbers of fruit. The disease appears to be more severe here on the winter crop wherever planted, which this year was almost a complete failure on account of this disease and the whipping by the heavy gales.

The disease may be prevented by frequent applications of bordeaux mixture to which is added fish oil soap at the rate of three pounds to every fifty gallons. Thorough application to both sides of the leaves with a fine misty spray is necessary.

Turnips

BLACK ROT. A rather severe outbreak of this bacterial disease occurred in the variety test plots at the Station.

(See under cabbage).

SOFT ROT. The black rot extended down into the roots making black streaks through the flesh. Following it, soft rot caused by **Bacillus caratovorous**, developed and destroyed many of the roots. Soft rot was also observed in turnips in a garden. No satisfactory method of control is known.

Respectfully submitted,

H. H. WHETZEL,

Pathologist (First Agricultural Assistant).

Agricultural Station,

6th. February, 1922.

REPORT OF THE GOVERNMENT VETERINARY OFFICER FOR THE YEAR 1921.

THE DIRECTOR OF AGRICULTURE,

I take pleasure in making the following report of the live stock conditions in the Colony.

There have been imported into the Colony 46 dairy cattle, 23 pigs for breeding purposes, and 134 dogs, principally the property of tourists.

Two of these dogs were landed at St. George's, one of them was inspected and the certificate obtained, the other one I have not been able to trace.

There have been no dogs placed in quarantine, although several have been confined to private premises for different periods.

Two animals have been destroyed for Tuberculosis, both of which were subjected to the test and a positive reaction obtained. One of these animals was a registered Guernsey bull the property of Mr. Geo. T. Miller of Smith's Parish, and the other a Holstein cow belonging to Messrs Hollis Bros. of Hamilton Parish. Two other animals were tested at or about this time, but no reaction was obtained.

I am very pleased to state that there has been no hog cholera in the Colony for three years. Several hogs were inoculated against the disease during the last six months, and as a whole the swine industry is in a very much improved condition.

Influenza in horses has shown itself during the fall and present month in a most virulent form, many animals having succumbed to its ravages, but is at present on the decline. I have had the holds of the steamers thoroughly cleaned by white-wash and disinfectant, as well, as the horse boxes in which the imported animals are conveyed, and it is probable that no contagion remains through this source.

As to the condition of the live stock generally, I am glad to report that it is tending toward improvement. The breeders of the Colony are taking more interest along pure breeding lines, which may be seen by the young progeny distributed through the Islands. I would strongly recommend that a live stock display should be made a very prominent part of the proposed agricultural exhibition to be held this year.

The stock at the Station is in excellent condition, and the addition of a fine bull calf to the herd is much appreciated.

R. L. TUCKER,
Government Veterinary Officer.

Smiths Parish.
11th. January, 1922.

REPORT OF THE SECOND AGRICULTURAL ASSISTANT ON BERMUDA'S AGRICULTURAL EXHIBITION AT THE CANADIAN NATIONAL EXHIBITION, 1921.

THE DIRECTOR OF AGRICULTURE,

It was not until early in June that the Department was able to begin to assemble specimens from which to select exhibits for the Colony's booth at the Canadian National Exhibition. At this date most vegetables were rather too far advanced in growth, but with the exercise of persistence, creditable specimens were eventually secured. A serious handicap was the impossibility of securing proper exhibition jars; such jars that were available were far too small to display the vegetables to advantage. Another difficulty was the inability to get the correct colour setting chemicals in time, and lack of funds also proved a serious obstacle. After many experiments, the following vegetable specimens were decided on and eventually exhibited; sweet corn, potatoes, onions, carrots, parsley, celery, tomatoes, leeks, kohl rabi, beans and arrowroot starch. With respect to exhibits of native plants and nursery stock, the Department was not at so great disadvantage, the only hinderance being a lack of time in which to get some of the plants properly established. This part of the exhibit consisted of cedars, oleanders, palmettoes, bananas, cycads, pandanus and draeaenas, and Easter lily, amaryllis, freesea and other bulbs. Photographs of local farming operations and samples of Bermuda soil were also shown.

The exhibits, as well as Bermuda's representatives, were transported as far as St. John, New Brunswick complimentary by the Royal Mail Steam Packet Company, and every assistance was rendered enroute by the Company's officers to ensure the safe arrival of the exhibits. Owing to the season of the year, it was considered best to carry the plants on deck, where they would have carried well, had the ship not experienced rough weather the second day out during which she shipped a heavy sea which drenched the plants, and this caused some of the leaves to fall off later on. From St. John the exhibits were shipped in bond to Toronto in care of the Dominion Express Company.

Bermuda was given one of the most favourable spots in the Government Building in which to stage her exhibits, situated slightly to the right facing the front entrance of the main building, and between the exhibits of the Ontario Department of Agriculture and the booth of the British Trade Commissioner. A large window above and powerful arc lights to the right and left afforded splendid light both day and night.

Great interest was manifested in the exhibit, and many compliments were paid to Bermuda's representatives by the Exhibition authorities on the staging. It was estimated that over 20,000 people paused before the booth each day, and many and varied were the questions asked. It was surprising to note how few were aware that Bermuda exported other vegetables than potatoes and

onions, and much surprise was shown that Canada had not availed herself more of such winter luxuries so near at hand. Owing to the necessity of both of Bermuda's representatives being busily engaged from 8 a. m. to 10.30 p. m. each day, it was impossible to find out much about the possibility of establishing markets for the Island's products in or around the city of Toronto.

The transportation charges being high, it was decided to store as much of the exhibit as possible in Toronto for possible further use, and accordingly things that were not perishable were placed in bonded warehouse. The plants were placed in the green houses of the City of Toronto in care of the Parks Commissioner and things impossible to keep were, with the permission of the customs authorities, destroyed.

Following are a few recommendations that might prove of value for similar occasion:

(1) Start to plan for and to assemble exhibits at least three months earlier.

(2) Get the best exhibition jars available, and spare no pains to have all exhibits shown to the best possible advantage.

(3) Decide upon and have all plants tubbed at least three months previous, so as to ensure their being well established.

(4) Include in exhibits, vegetables and fruits peculiar to Bermuda.

(5) Put more color into exhibit of plants to attract attention.

(6) Have abundance of literature, and preferably have it printed in Canada.

(7) Have picture cards and leaflets in abundance, rather than the large booklet "Beautiful Bermuda" which is far too expensive for the wholesale distribution that is expected.

JOSEPH J. OUTERBRIDGE,
Second Agricultural Assistant.

Agricultural Station,
6th February, 1922.

REPORT OF THE INSPECTOR OF GREEN VEGETABLES FOR THE SEASON OF 1920-1921.

THE CHAIRMAN,
BOARD OF AGRICULTURE.

Sir,

I have the honour to forward for the information of the Board of Agriculture my report on the inspection of green vegetables shipped from the Colony during the season of 1920-1921.

On my appointment to the office of Inspector of Green Vegetables on the 15th November, 1920, I entered on my duties immediately.

The season opened with a shipment of 238 crates of green vegetables by the S. S. Fort Hamilton on 30th November, 1920. As stated in my previous report the chillroom accomodation on this steamer was amply sufficient for all the demands of the trade.

With few exceptions the carrot seed was satisfactory, being of the long-shaped variety which is most acceptable to the New York trade. The short, bulky variety should, if possible, be eliminated, as it is not at all suitable to our principal market. Beets did not, on the whole, attain the standard of previous years. The variety grown was generally of a coarse quality. The tops were too long and bulky, and the root usually much too small in proportion to the amount of foliage. Further, the deep red colour so much in demand was wanting. The season's crop of lettuce was almost a complete failure. Competition was keen, and the quality of our shipments was so poor that it was totally unable to stand a chance in the market. The generally poor result suggests that the seed imported was not of the variety which proved successful in previous years. Parsley was on the whole of good quality. Some small quantities, however, showed a lack of vitality, due, no doubt, to the want of cultivation, poverty of soil, and general absence of care during the period of growth. The celery was very good. A few small lots only were of inferior quality.

Rejected on Inspection—Celery, large	209	crates—	0.34%
Celery, small	537	" —	4. %
Vegetables	2432	" —	1.05%

The percentage rejected on the whole crop works out approximately to 1.3.

REFERENCES AND APPEALS. There were three appeals. The decisions of the Inspectors were upheld.

PROSECUTIONS. None.

REPACKINGS. As usual I have to thank the Wharfinger, Captain N. Holmes, for the allotment of space for repacking.

QUANTITIES SHIPPED. The following quantities were shipped to New York:

Beans, Fava	697	bushel	crates
Beets	31,845	"	"
Carrots	115,143	"	"
Celery	31,979	"	"
Kale	23,311	"	"
Lettuce	7,269	"	"
Parsley	64,514½	"	"
Peas	73	"	"
Turnips	518	"	"
Miscellaneous	191	"	"
Total	275,540½	"	"

In addition to the above quantity, 323 crates of tomatoes and 40 crates of carrots were shipped to Canada, and 95 crates of carrots to the West Indies.

SUPERVISION OF CHILLROOMS and Market Investigations. I made, by order of the Board of Agriculture, four trips to New York, between January 22nd and June 1st, 1921, for the purpose of observing the condition of vegetables in transit and on landing, and other matters affecting the green vegetable industry. Full reports of these trips were forwarded to the Director of Agriculture.

EXPENDITURE. All expenditure connected with inspection service amounted to £282-3-0. £197-12-2 was expended in the supervision of chillrooms and market investigations.

RECOMMENDATIONS AND SUGGESTIONS. I beg respectfully to submit, as an outcome of my observations during the past season, the following:

1. The varieties of carrot, such as the Half-long and Danvers are most in demand in New York; while the short varieties like Oxheart are not ready sellers. I should recommend that farmers bear these facts in mind.

2. A beet like the Egyptian Turnip with small foliage and deep red flesh will always sell readily. Coarser varieties such as Crosby's Egyptian with heavy foliage and light coloured flesh, sell slowly, and are, in my opinion, unprofitable to grow for export.

3. It would, in my opinion, be to the advantage of the farmer to trim off excessive foliage of beets and carrots when packing for shipment.

4. I have, in previous reports, recommended the use of a standard crate for celery. Recent experience convinces me that a package, two-thirds of the capacity of the present "large" crate would be most convenient for handling and storage. No celery should be shipped in any but the standard crate of the capacity mentioned above.

I have the honour to be,
Sir,
Your obedient servant,
G. E. WINTER,
Inspector of Green Vegetables.

Devonshire,
7th September, 1921.

APPENDIX A.

FINANCIAL STATEMENT FOR THE YEAR ENDED 31ST. DECEMBER, 1921.

Agricultural Department Act, 1912.

Appropriated for payment of members of Board ..				£80	0	0
Paid to members for attendance	£ 76	0	0			
Unexpended balance	4	0	0			
	80	0	0	80	0	0
Appropriated for general purposes of Act				2000	0	0
Paid for Clerical and Technical assistance	175	17	10			
Field labour, experimental plots, lawns and flower beds, care of live stock, etc. ..	915	2	10			
Cartage and plowing	54	5	0			
Manure and fertilizers	112	12	2			
Seed potatoes, seeds and bulbs	102	0	11			
Insecticides and fungicides	49	10	2			
Empty barrels and box shucks	48	9	2			
Live stock, feed	98	12	9			
Live stock, alteration of stables, expenses incidental to purchase, etc.	78	2	9			
Repairs and renewal of tools, implements, etc.	99	11	10			
Electric lighting, power, etc.	23	2	8			
Telephones, rent of	6	10	0			
Books and periodicals	27	12	10			
Typewriters, purchase and repairs	29	3	9			
Stationery and printing	66	12	10			
Postage, foreign	10	10	0			
Agricultural Clubs, prizes to	11	3	0			
Toronto Exhibition, contribution to expense of Bermuda exhibit	51	5	0			
Sundry expenses	19	14	11			
Unexpended balance			4			
	£2000	0	0	£2000	0	0
Appropriated for travelling expenses of Department				£40	0	0
Paid for carriage hire	£24	13	0			
Steamer fares	1	4	9			
Unexpended balance	14	2	3			
	40	0	0	40	0	0
Appropriated for supervision of chillrooms and market investigations				300	0	0
Paid for cable service	51	17	0			
Expenses of representative in New York..	197	12	2			
Unexpended balance	50	10	10			
	300	0	0	300	0	0
Appropriated for improvement of live stock				850	0	0
Paid for animals	726	18	0			
Contingencies	113	7	1			
Supplies	9	14	11			
	850	0	0	850	0	0

PRODUCE INSPECTION ACT, 1906, AND POTATO IMPORTATION ACT, 1914.

Appropriated for purposes of Acts				£750	0	0
Paid for inspection at dock	£387	2	0			
Field inspection in United States & Canada	202	1	3			
Potatoes for testing and other supplies	31	15	8			
Unexpended balance	139	1	1			
	750	0	0	750	0	0

Green Vegetable Inspection Act, 1912.

Appropriated for purposes of Act				£300	0	0
Paid for inspection at dock and supervision of stowage	281	0	0			
Supplies		13	0			
Unexpended balance	18	7	0			
	£300	0	0	£300	0	0

Animal Diseases Act, 1914.

Appropriated for purposes of Act				£100	0	0
Paid for compensation	£30	0	0			
Supplies	2	10	1			
Unexpended balance	67	9	11			
	100	0	0	100	0	0

Agriculture Department Act, 1921.

Appropriated for purposes of Act (Purchase of equipment				£250	0	0
Paid for purchase of equipment and contingencies	160	7	9			
Unexpended balance	89	12	3			
	250	0	0	250	0	0

Plant and Bulb Disease and Pests Act, 1921.

Appropriated for purposes of Act				1000	0	0
Paid for two motor sprayers	298	13	1			
Other equipment and supplies	129	11	11			
Insecticides	270	14	9			
Labour and horse hire	300	17	6			
Unexpended balance		2	9			
	1000	0	0	1000	0	0

Washington Committee Resolve, 1921.

Appropriated for purposes of Resolve,				192	1	7
Expenses of Committee	192	1	7			
	£192	1	7	£192	1	7

APPENDIX B.

STATEMENT OF REIMBURSEMENTS TO GOVERNMENT DURING THE YEAR ENDED 31ST. DECEMBER, 1921.

Sales of potatoes, vegetables and plants	£149	13	7
Live stock fees	19	12	0
Miscellaneous	6	16	4
	£176	1	11

Statement of Produce Supplied to other Government Institutions

Vegetables, King Edward VII Memorial Hospital	£55	5	0
Vegetables, Hamilton Gaol	4	10	0
Vegetables, Lunatic Asylum	6	0	0
Milk, King Edward VII Memorial Hospital 548 quarts at 1- per qt.	27	8	0
	93	3	0

E. A. McCALLAN,
Director of Agriculture.

6th. February, 1922.